CONSUMER CASUALTIES

Exploring the Economics of Habit, Information, and Uncertainty in Japan

Junmin Wan

Consumer Casualties

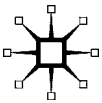
This page intentionally left blank

Consumer Casualties

Exploring the Economics of Habit, Information, and Uncertainty in Japan

Junmin Wan

palgrave
macmillan



CONSUMER CASUALTIES
Copyright © Junmin Wan, 2014.
Softcover reprint of the hardcover 1st edition 2014 978-1-137-38724-0
All right reserved.

First published in 2014 by
PALGRAVE MACMILLAN®
in the United States—a division of St. Martins Press LLC,
175 Fifth Avenue, New York, NY 10010.

Where this book is distributed in the UK, Europe and the rest of the world, this is by Palgrave Macmillan, a division of Macmillan Publishers Limited, registered in England, company number 785998, of Houndmills, Basingstoke, Hampshire RG21 6XS.

Palgrave Macmillan is the global academic imprint of the above companies and has companies and representatives throughout the world.

Palgrave® and Macmillan® are registered trademarks in the United States, the United Kingdom, Europe and other countries.

ISBN 978-1-349-48183-5 ISBN 978-1-137-38484-3 (ebook)
DOI 10.1057/9781137384843

Library of Congress Cataloging-in-Publication Data

Wan, Junmin.
Consumer casualties : exploring the economics of habit, information, and uncertainty in Japan / Junmin Wan.
pages cm
Summary: "In our increasingly globalized world of shared cultures, we have seen the spread of addictive behaviors such as smoking and various forms of gambling. As these behaviors and subsequent habits continue to spread across borders, it is paramount for policy makers to consider the economics of habit, information and uncertainty in their practices.Junmin Wan takes a two prong approach to analyzing this pressure in Japan in his new volume Consumer Casualties. He first clarifies the consumer preference for habit to identify useful approaches toward solving a number of economic issues, such as gambling and other addictive practices. He then tests his theories with data on smoking, lottery gambling and pachinko gambling, to determine their causalities and distill proposals for policy makers"– Provided by publisher.
Summary: "This work tries to examine the economics of habits via theoretical models and empirical testing of the models using micro and macro datasets, as they pertain to addressing various economics issues, including habit forming or addictive behaviors such as smoking and various forms of gambling. The issues of information asymmetry (e.g., the effect of lottery receipt on experiment on tax evasion) and uncertainty as they pertain to consumers and their preferences and habits are also included"– Provided by publisher.
Includes bibliographical references and index.

1. Consumer behavior–Japan. 2. Branding (Marketing)–Japan. 3. Business ethics–Japan. I. Title.

HF5415.32.W366 2014
658.8'3420952–dc23 2014019485

A catalogue record of the book is available from the British Library.

Design by Newgen Knowledge Works (P) Ltd., Chennai, India.

First edition: November 2014

10 9 8 7 6 5 4 3 2 1

To my family.

This page intentionally left blank

Contents

This page intentionally left blank

Figures

Tables

This page intentionally left blank

Acknowledgments

I would like to express my sincere gratitude to the many professors, fellow students, friends, scholarship foundations, and family members who have given me academic, financial, and intellectual support since I came to Japan, for the first time in 1993. This study could not have been undertaken without their support.

First, I am deeply indebted to my supervisor, Professor Kazuo Ogawa. He has always given me helpful academic advice and encouragement; this support proved invaluable when I was hesitant with my research. He also offered financial support when money was tight and served as a legal guarantor for my family while they stayed in Japan and when I started a family. When I completed an article, he would always let me present it in his study and gave me helpful comments after my presentation. He would always tell me that my research was interesting and advise me to go into more detail, without giving me a specific direction (so I would forge my own direction). I am grateful to have and received this kind of help and encouragement for four years. I will always remember this time of my life and hope to pay it forward to my students in the future.

I would also like to thank Professor Charles Yuji Horioka. He has helped me with valuable advice during the course of my research ever since I first met him, at the beginning of 2001. He has also helped improve the English in a number of articles. Since April, 2001, I have taken part in Professor Horioka's seminars at the Institute of Social and Economic Research, not only were the seminars by themselves were interesting and beneficial to me, but the lunches after the seminars have also proven to be most helpful.

I have received many benefits from these seminars, including advice with regard to future research as well as advice on life in Japan. I will always remember his kindness to me.

I would also like to thank Professor Fumio Ohtake. I attended his undergraduate lecture on "Labor Economics" in 1998 and found the approach to labor economics presented there difficult but interesting. I attended his graduate class that was focused on "Micro Econometrics" throughout 2001 and 2002, and learned a lot. For example, I learned about the "natural experiment" approach in labor economics and started to think about how I could apply this approach to other fields of economics. He also offered me many beneficial and encouraging comments in relation to my master's dissertation and other articles.

I would also like to give special thanks to Professor Shinsuke Ikeda. I have attended his "Macroeconomics Research Seminar" since April 2001 and his "Asset Pricing Research Seminar" since April 2002. I learned about many theories by attending these seminars. I also had many opportunities to present my drafts and to receive helpful comments in these two seminars. I also fortunate to have his personal guidance with respect to my drafts after the seminars. He also offered help in other ways, such as in the use of econometric software, with respect to attending academic junkets, etc. His help has been invaluable to my previous and current research, and I am sure it will prove to be equally so in the future.

I also would like to thank Professor Yoshiyasu Ono. I attended his undergraduate lectures "Dynamic Macroeconomics" in 1999 and his graduate lessons from 2000 to 2003. He enlightened me as to how interesting and simultaneously difficult "macroeconomics" was and let me know the appropriate stance of an economist. I will not forget his kindness at various social occasions, such as at the Christmas party at his home, etc., nor will I forget the benefits of his academic rigor.

I would also like to thank Professor Yuzo Honda. I attended his undergraduate "Research Seminar" in 1998 and 1999. I learned a lot from him. I can still remember three points from his research seminar. First, that ordinary least squares analysis is essentially different from cointegration analysis, which I used in my bachelor's thesis. Second, that in choosing a subject to research, I should

differentiate it clearly from the topics of other researchers. Third, he made the point that, in order to test whether I had made a point clearly, I should read it out to another individual; if that person had difficulty in understanding the point, then it means that further work needs to be done with respect to my own grasp of the topic.

I would also like to thank Fatt-Seng Chong, Ichiro Gombi, Kenichi Hashimoto, Keiichi Hori, Wataru Jodo, Daiji Kawaguchi, Wenjie Ma, Hideki Mizukami, Jie Qin, Xiangyu Qu, Kei Sakata, Shizu Sekita, Dong Sheng, Darek Stanko, Wataru Suzuki, Keiko Tamada, Takanori Tanaka, Jun Tomioka, Midori Wakabayashi, Wako Watanabe, Keiko Yoshida, Yanfei Zhou, and many other seminar participants at Osaka University for their beneficial suggestions and comments.

I am also grateful to the Ace Research Institute, the Japanese Lottery Association, and the Institute of Social Science at the University of Tokyo (SSJ Data Archive), the Japanese Tobacco Association, for providing invaluable data. I would also like to thank the Rotary Yoneyama Foundation and the Osaka Otemae Rotary Club for their financial support in 2003 and 2004. I would especially like to thank my counselors Toshikazu Tachikawa and Chuta Takaori for their kindness. In addition, I would like to thank the Ministry of Education, Culture, Sports, Science and Technology (Monbukagakusho) for their honors scholarship for privately-financed international students in 1996, 1997, 1999, and 2001. I am also grateful to the Asia International Foundation in Japan for the Kawaguchi Shizu Memorial Scholarship in 2000.

I would like to give special thanks to Masamitsu Shinoda's family and to Toshio Tokumura's family. They were the guarantors for my study and stay in Japan. I have received much help from them over the past 11 years. I would also like to express my gratitude to my wife, my parents, and my uncle's family. I am grateful to Osaka University, especially the School of Economics, for giving me a chance to study economics systematically for 9 years. I would also like to thank the Health Agency of Jiangxi Province, The People's Republic of China, for permitting me to quit my job there in order to study economics.

I would like to express my thanks to Seki Asano of Tokyo Metropolitan University, Frank J. Chaloupka, Ichirou Gombi of

Ritsumeikan University, Noriko Hashimoto of Kansai University, Atsushi Kajii of Kyoto University, Mino Kazuo, David Merriman, Mikiyo Kii Niizeki of Doshisha University, Megumi Okui of Kanazawa Gakuin University, Keunkwan Ryu of Seoul National University, Toshiki Watanabe of Chuo University, Yan Xu, participants at many seminars, Japanese Lottery Association, and Mizuho Bank for their valuable advice, comments, and supports in various ways.

I also thank Qiang Li and Yaohui Zhao for their hospitality when I visited Institute of Social Science Survey, Peking Univeristy from August 2012 to July 2013. I partially revised the contents of this book there. I also give my thanks to Fukuoka University for giving me a sabbatical year and providing me the fund for stay at Beijing.

Finally, I give my deep thanks to Ms. Leila Campoli, Ms. Deepa John, Ms. Sarah Lawrence, and Ms. Rachel Taenzler at Palgrave Macmillan, New York, for without their help I could not have published this work. Any remaining errors are my responsibility.

1

Introduction

1.1 Objectives of This Research

There were two objectives in pursuing this study. One was to clarify the consumer preference for habit, information, and uncertainty (and wealth) in order to identify useful approaches for solving a number of economic issues (such as gambling, spurious bubble, bubble, etc.). The other was to test a number of theories in the field of economics in order to determine their causalities and validities by "natural experiment," and to make a number of proposals for policy making. These two points will be elaborated more explicitly in the following section.

First, I maintain, like most economists, that a market-oriented economy is better than a centrally planned economy, as an economic system. In a market economy, however, there are series problems, such as negative externality, bubble crash (Scheinkman and Xiong, 2003), etc. For example, there have been serious consequences in the Japanese economy since the bubble crash at the end of the 1980s. Important questions in this respect are, what should be done after a bubble crash, and why did the bubble occur in the 1980s? Ogawa (2003) has pointed out that the bubble crash caused a decrease in firm investment, and an increase in bad debts, in banks. He also proposed that the bad debts of firms and banks should be resolved in order for the economy to recover. Ogawa and Wan (2004, 2007) pointed out that the bubble crash also caused bad debt within Japanese households and a decrease in consumption; they proposed that

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

the bad debts of households should also be resolved in the current recession. These studies are ex post and are useful for the current recession. However, the best solution is the prevention of bubbles arising in the first place. We still do not understand clearly why this phenomenon arises. There may be many factors involved, including the behavior of consumers, firms, the government, as well as social norms, etc. I focus here on consumers' preference with respect to habit, information, uncertainty and wealth. This is because, when consumers make decisions, their habits (historical activities), current information, and preference with respect to future uncertainty, and wealth will essentially influence their decisions and activities after their decisions. For example, if consumers persist in seeking money or wealth, a spurious bubble (persistent deflation) may take place.[1] There are also other phenomena that are analogous to an economic bubble. For example, a gambler pays for (gambling) a significantly negative expected return, and yet the purpose of gambling is to win. If the gambler is addicted to gambling, he or she may become bankrupt (something akin to a bubble crash).[2] If a consumer does not have sufficient information regarding goods, he or she may over- or underconsume these goods because his or her shadow price or willingness to pay[3] may be mistaken, as compared to a situation in which he or she has optimal, full information.

Second, there are many theories, with supporting evidence, that offer explanations but not the causalities, or the interior mechanisms, of economic facts or issues; this is because there are too many unobservable characters with respect to economic issues. For any one economic fact, there are always many seemingly logical explanations, with the most appropriate explanation being one of many. Therefore, there could be too much theoretical "noise," which could mislead an expert or a governing body. We need to clarify which of the available explanations describes the interior mechanism of an economic phenomenon and shows causality. This is difficult to do because we cannot provide the solutions to social issues in the same way as conducting a natural science experiment in the laboratory. Social experiments involve huge costs and require extensive periods of time. However, if

we can identify historical events that are sufficiently close to experiments, as would be performed in a laboratory, we may more easily test economic theories and identify the causality of economic phenomena. This approach has been termed that of the "natural experiment[4]" in recent economic studies. I have used this approach to test a number of theories (some elaborated) and to make proposals for economists involved in policy making.

1.2 Motivation for, and Structure of, This Book

Why have I undertaken research into consumers' preferences for habit, information, uncertainty, and wealth? Because a consumer's habit (historical activities), current information, and preference for uncertainty and wealth with respect to the future will essentially influence his or her decision making and activity after making the decision. The reason for using the "natural experiment" approach is that I wish to test economic theories, and to find the causality behind economic facts, by using historical events that do not involve high costs in terms of time and money.

It is very difficult to empirically test the habit, information, and uncertainty issues set out above because they are too abstract, even though these factors play invaluable roles in economics. I have found that the consumption of some unique goods and certain activities, such as cigarettes, pachinko gambling, and lottery gambling, can provide suitable tests for the issues of habit, information, and uncertainty. I have also found that there are many historical events that show a similarity to natural experiments in Japan and China. Therefore, I have analyzed these events, case by case, according to a number of standard theories in economics. In every case study or chapter, the keywords habit, information, uncertainty, and natural experiment occur regularly.

Chapter 2 develops a theoretical model in which the rational addictive consumer sets out an optimal inventory for tax change and empirically tests it. Before the tax increase, the government makes a new law implementing it and announces it. Thus, consumers can use perfect foresight with respect to future tax

and price in order to decide their own optimal consumption and inventory. There are many events of this type in Japan; these events can be considered natural experiments.

Chapter 3 develops a theoretical model in which the rational, addictive consumer makes an optimal decision for consumption based on limited information about the health damage caused by consumption. This chapter also tests the model using time-series data and several national surveys on smoking in Japan.

Chapter 4 introduces a new way to examine the effects of mandatory information disclosure on interbrand cigarette demand and the behavior of a monopolistic firm in Japan. The mandatory disclosure of nicotine and tar content can also be considered a natural experiment.

Chapter 5 discusses the addictiveness of pachinko gambling using individual data from Japanese pachinko surveys. The gain from gambling is uncertain before the gambler participates in the activity.

Chapter 6 analyzes pachinko gambling and cigarette smoking, simultaneously, using some unique questions arising from individual data from the Japanese Pachinko Survey. The two goods are addictive and exhibit uncertainty. Uncertainty about winning means that pachinko play constitutes gambling. Health damage occurs from smoking; thus, gain from smoking is also under uncertainty.

Chapter 7 highlights a new system of taxation implemented in China both theoretically and empirically. A lottery receipt system has been introduced and has been implemented as an experiment in many areas. It constitutes a real social experiment in that it is recognized as an experiment by the present government of China. The lottery is used to avoid information asymmetry between the government and firms. The lottery buyer's gain from the lottery is uncertain.

Chapter 8 first theoretically analyzes the linkage between the Life Cycle and Ono's models, then tests them empirically using time-series data and several surveys on lottery purchase and on big prize winners in Japan. The gain from a lottery is uncertain. The prize winners are randomly determined by the lottery numbers; this type of event also constitutes a natural experiment.

Chapter 9 concludes the book and presents some issues for future research.

1.3 Main Findings and Issues Left for Future Research

The main findings and issues left for future research are summarized in Chapter 9. There have been numerous findings arising from this study in addition to a number of proposals for economists and policy makers. See Chapter 9 for details.

2

Rational Addiction with an Optimal Inventory: Theory and Evidence from Japanese Daily and Monthly Purchases

2.1 Introduction

There are two main issues when estimating demand or supply equations. One is that the price becomes endogenous because demand and supply are determined simultaneously. Therefore, it is very difficult to estimate the demand or supply equation using aggregate data. A natural experiment constitutes a good approach for solving this problem. For example, Angrist et al. (2000) use typhoons as an instrument for price in estimating fish demand. The second issue is that the price becomes endogenous because some unobserved factors become omitted variables in the error term and correlate with the price. For example, rational consumer behavior, like hoarding when faced with a price increase, is correlated with price.

These two issues have not been resolved well in previous research. For example, in Becker et al. (1994), it is difficult to consider the price of cigarettes as exogenous to the consumer for two reasons. First, the price is determined by several oligopoly companies. Second, cigarette sales are considered to equal consumption (as a proxy for cigarette consumption), because it is difficult to observe actual cigarette use. Consumer hoarding behavior before an increase of cigarette tax is not considered.

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

Recently, several articles have analyzed the consumer's inventory. Feenstra and Shapiro (2001) have pointed out that the Consumer Price Index (CPI) cannot be calculated exactly if the inventory is not considered, and they have tested this using data for canned tuna. Hendel and Nevo (2001) analyzed supermarket sales and the consumer inventory and tested their model using data on soft drinks. Nevertheless, some important points have not been analyzed in detail: (1) perishable goods, (2) the correlation between inventory and the price included in the error term, (3) a suitable proxy for inventory, (4) addictive goods, and (5) the timing of hoarding.

This chapter resolves these points. I develop a rational addiction (RA) model with an optimal inventory to distinguish between purchase and consumption, and I test the model using daily and monthly cigarette purchases in Japan, where the central government controls the price of cigarettes. Consequently, the price is exogenous to consumers and thus can be considered a natural experiment. Moreover, because a new law must be passed before changing cigarette taxes in Japan, the cigarette consumer has perfect foresight concerning price. Consumers are thought to hoard just before a tax increase. Therefore, purchases do not always equal consumption, especially in the short run. If the hoarding correlated with a price or tax change is not included in the estimation equation, while it is included in the error term, no consistent estimator will be obtained. In many cases consumers hoard large amounts just before a tax increase. The RA model is not supported when the inventory is not considered, whereas it is supported when it is considered.

This chapter is organized as follows: the theoretical framework is presented in Section 2.2. Empirical tests and results are presented in Section 2.3. Conclusions are presented in Section 2.4.

2.2 Theoretical Framework

2.2.1 Model Setting

A representative consumer is assumed to consume two types of goods: services, which cannot be stored, and addictive goods, such

as cigarettes, which can be stored for a limited time. The consumer has to choose optimal consumption, purchase, and inventory at every period to maximize her utility and income. Because there are so many choices, the consumer's problem becomes very complicated. To simplify the problem, I transform it into a two-stage decision problem without losing generality. In the first stage, the consumer is assumed to choose her optimal consumption based on his or her income. In the second stage, the consumer is assumed to choose his or her optimal purchases and inventory when the optimal consumption is given.

2.2.2 *First-Stage Decision: Optimal Consumption*

Rational Addiction Model

According to Becker et al. (1994), a consumer is assumed to be infinitely lived and to maximize her lifetime utility, discounted at the rate r. This utility has two components: the euphoria from addictive goods, such as cigarettes, and service. The consumer's problem can be expressed as

$$\max \sum_{t=1}^{\infty} \beta^{t-1} U(C_t, C_{t-1}, Y_t, e_t), \tag{2.1}$$

$$\overline{s.t.} \sum_{t=1}^{\infty} \beta^{t-1}(Y_t + P_t C_t) = A^0,$$

$$\beta = 1/(1+r).$$

Here C_t, C_{t-1} are the quantities of cigarettes consumed in periods t and $t-1$, respectively. Y_t is the consumption of the composite commodity in period t, and e_t reflects the impact of unmeasured life cycle variables on utility. The composite commodity, Y, is taken as the numeraire so that the price of cigarettes in period t is denoted by P_t. The rate of interest is assumed to equal the rate of time preference. β is the time discount factor. Any effect of C on earnings and on the present value of wealth (A^0) is ignored. The same applies to the effect of C on other types of uncertainty. The initial condition for the consumer in period 1, C^0, measures the

level of cigarette consumption in the period before the one under consideration.

The associated first-order conditions are

$$U_y(C_t, C_{t-1}, Y_t, e_t) = \lambda, \tag{2.2}$$

$$U_1(C_t, C_{t-1}, Y_t, e_t) + \beta U_2(C_{t+1}, C_t, Y_{t+1}, e_{t+1}) = \lambda P_t. \tag{2.3}$$

A consumption euphoria function that is quadratic in Y_t, C_t, and e_t is considered. By solving the first-order condition for Y_t and substituting it into the first-order condition for C_t, a linear difference equation can be derived:

$$C_t = \theta_0 + \theta C_{t-1} + \beta\theta C_{t+1} + \theta_1 P_t + \theta_2 e_t + \theta_3 e_{t+1}, \tag{2.4}$$

where[1]

$$\theta_0 = -\lambda(u_{y1} + \beta u_{y2}),$$

$$\theta = \frac{-(u_{12}u_{yy} - u_{1y}u_{2y})}{(u_{11}u_{yy} - u_{1y}^2) + \beta(u_{22}u_{yy} - u_{2y}^2)},$$

$$\theta_1 = \frac{u_{yy}\lambda}{(u_{11}u_{yy} - u_{1y}^2) + \beta(u_{22}u_{yy} - u_{2y}^2)},$$

$$\theta_2 = \frac{-(u_{yy}u_{1e} - u_{1y}u_{ey})}{(u_{11}u_{yy} - u_{1y}^2) + \beta(u_{22}u_{yy} - u_{2y}^2)},$$

$$\theta_3 = \frac{-\beta(u_{yy}u_{2e} - u_{2y}u_{ey})}{(u_{11}u_{yy} - u_{1y}^2) + \beta(u_{22}u_{yy} - u_{2y}^2)}.$$

A good is addictive if $\theta > 0$, and the degree of addiction increases with θ. The roots of the difference equation (2.4) are

$$\phi_1 = \frac{1 - (1 - 4\theta^2\beta)^{1/2}}{2\theta},$$

$$\phi_2 = \frac{1 + (1 - 4\theta^2\beta)^{1/2}}{2\theta}, \tag{2.5}$$

and the stability conditions are

$$4\theta^2\beta < 1,\ \phi_1 < 1,\ \phi_2 > 1. \tag{2.6}$$

Given these roots, the temporary current, past, and future price effects are

$$\frac{dC_t}{dP_t} = \frac{\theta_1}{\theta\phi_2}, \tag{2.7}$$

$$\frac{dC_t}{dP_{t-1}} = \frac{\theta_1}{\theta(\phi_2)^2}, \tag{2.8}$$

$$\frac{dC_t}{dP_{t+1}} = \frac{\theta_1\phi_1}{\theta\phi_2}. \tag{2.9}$$

All the roots are negative, since θ_1 is negative.

The short-run price effect is

$$\frac{dC_t}{dP^*} = \frac{\theta_1}{\theta(1-\phi_1)\phi_2}, \tag{2.10}$$

which is defined as the impact of a reduction in the current and all future prices on current consumption, with past consumption held constant.

The long-run price effect is

$$\frac{dC_\infty}{dP} = \frac{\theta_1}{\theta(1-\phi_1)(\phi_2-1)}, \tag{2.11}$$

which is defined as the effect of a permanent reduction in prices in all periods.[2]

Issues in the Empirical Analysis

The consumption set $(C_1,\ldots,C_T)$ is decided optimally, although in the empirical analysis C is very difficult to observe. We often lack consumption data and have aggregate data on purchases. Nevertheless, purchases do not equal consumption, especially in the short run.

2.2.3 Second-Stage Decision: Optimal Purchase and Inventory

Optimal purchases and inventory when the consumption is given

The optimal consumption set in the first-stage problem is assumed to be given. In this stage, the consumer is assumed to choose her optimal purchases and inventory in every period. In this model, I

make the following assumptions to simplify the analysis without losing generality.

Cigarettes are perishable and have a best before date or a time limit. This period is assumed to be T^l. According to "history of tobacco monopoly (Japan Tobacco and Salt Corporation, 1963–1990)," this period is about 5 months. I also assume that there are no new tax increases or decreases during this period after a tax or price change. I also assume that the price is known with perfect foresight. This is the case in Japan because the Japanese government regulates cigarette prices. The Japanese Diet must enact a new law before any tax increase can be implemented. The inventory cost is assumed to be a function of inventory, $F(I_t)$, where $F'(I_t) > 0, F''(I_t) > 0, F(0) = 0$. The shopping cost is assumed to be zero; this is reasonable because cigarette vending machines are located everywhere in Japan.

Under these assumptions, the consumer's optimal strategy is when the inventory is zero and purchases equal consumption in the period after time T^l. Therefore, the consumer considers a cost minimization problem during one cycle of the cigarette storage time limit:

$$\min_{Q_t, I_t} = \sum_{t=1}^{T^l} (1+r)^{-t}[P_t Q_t + F(I_t)], \tag{2.12}$$

$$\begin{aligned} \overline{s.t.} \quad & -I_t \le 0; \\ & -Q_t \le 0; \\ & I_t = Q_t + I_{t-1} - C_t; \\ & Q_0 = 0;\ I_0 = 0;\ \ P_t > 0;\ \ C_t > 0;\ \ I_{T^l} = 0. \end{aligned}$$

The Lagrangean function can be written as

$$\begin{aligned} L = \textstyle\sum_{t=1}^{T^l} (1+r)^{-t}[P_t Q_t + F(I_t)] + \sum_{t=1}^{T^l} \lambda_t(\ -I_t) + \sum_{t=1}^{T^l} \gamma_t(-Q_t) \\ + \quad \sum_{t=1}^{T^l} \mu_t[I_t - (Q_t + I_{t-1} - C_t)]. \end{aligned} \tag{2.13}$$

where λ_t, γ_t, and μ_t are the Lagrangean multipliers. The first-order conditions are

$$\frac{\partial L}{Q_t} = 0, \ \rightarrow \ (1+r)^{-t}P_t - \gamma_t - \mu_t = 0; \tag{2.14}$$

$$\frac{\partial L}{I_t} = 0, \ \rightarrow \ (1+r)^{-t}F'(I_t) - \lambda_t + (\mu_t - \mu_{t+1}) = 0; \tag{2.15}$$

$$\frac{\partial L}{\mu_t} = 0, \ \rightarrow \ I_t - (Q_t + I_{t-1} - C_t) = 0. \tag{2.16}$$

Proposition 2.1 If a price or tax increase occurs at time 2, $(1+r)(P_2/P_1)$, and the price remain constant until time T^l, the optimal strategy for purchases and inventory is to buy new cigarettes only if the inventory becomes zero and the optimal inventory after time 2 decreases with time due to consumption. The proof is in Appendix 2A.

Proposition 2.2 If the price or tax increases at time 2, $(1+r)(P_2/P_1)$ and the price remain constant until time T^l, the optimal inventory at time 1 is unique. $0 \leq I_1^* \leq \sum_{t=2}^{T^l} C_t$, and I_1^* is a function of P_2/P_1, inventory cost, and the time limit. It increases with P_2/P_1 and the time limit but decreases with the inventory cost. The proof is in Appendix 2A.

Following Proposition 2.1, the consumer's purchases will be zero if the inventory exceeds the consumption during time t. Therefore, before a price or tax increase, purchases will exceed consumption, while purchases will be zero during some period after a price or tax increase. In addition, $\Delta I_1 = I_1$ because $I_0 = 0$. We can test such optimal consumer behavior in an empirical analysis.

2.2.4 Solutions to the Issues Raised in the Empirical Model

In the first-stage problem, the consumption set is derived. However, we cannot observe the aggregate quantity of consumption. We only have purchase data. Therefore, we must use the purchase equation in the second stage and substitute purchases for consumption C_t in the first stage:

$$Q_t = I_t - I_{t-1} + C_t = \Delta I_t + C_t,$$

$$= \theta_0 + \theta C_{t-1} + \beta\theta C_{t+1} + \theta P_t + \theta_2 e_t + \theta_3 e_{t+1} + \Delta I_t. \quad (2.17)$$

Note that $C_{t-1} = Q_{t-1} - \Delta I_{t-1}$, and $C_{t+1} = Q_{t+1} - \Delta I_{t+1}$. Therefore, Q_t can be represented in the following form:

$$Q_t = \theta_0 + \theta Q_{t-1} + \beta\theta Q_{t+1} + \theta P_t + \theta_2 e_t + \theta_3 e_{t+1} + (\Delta I_t - \theta \Delta I_{t-1} - \beta\theta \Delta I_{t+1}). \quad (2.18)$$

$(\Delta I_t - \theta \Delta I_{t-1} - \beta\theta \Delta I_{t+1})$ is the effect of inventory, where

$$\overline{Cov}(P_t, \Delta I_t - \theta \Delta I_{t-1} - \beta\theta \Delta I_{t+1}) \neq 0.$$

Since the inventory also correlates with the tax change or the lead and lag of the price, the error term will correlate with the price (or tax rate) when $(\Delta I_t - \theta \Delta I_{t-1} - \beta\theta \Delta I_{t+1})$ is not included in the right-hand side of the structural model. This is a typical endogenous issue caused by omitting a variable correlated with the explanatory variable.

In the second-stage decision problem, I derive the optimal inventory and know ΔI_t in every period. Therefore, I can use T^l dummies to indicate ΔI_t, one dummy for the hoarding effect and $T^l - 1$ dummies for storage effects after hoarding. Since the time limit of Japanese cigarettes is about 5 months and distribution takes about 2 months, the consumer storage period is about 3 months.

$\overline{Time}$,	$\overline{Price}_t$,	$\overline{Hoarding}_t$,	$\overline{Store}1_t$,	$\overline{Store}2_t$,	$\overline{Store}3_t$	……	$\overline{Store}T^l_t$
$t-4$	P_1	0	0	0	0	……	0
$t-3$	P_1	0	0	0	0	……	0
$t-2$	P_1	0	0	0	0	……	0
$t-1$	P_1	0	0	0	0	……	0
t	P_1	P_2/P_1	0	0	0	……	0
$t+1$	P_2	0	P_2/P_1	0	0	……	0
$t+2$	P_2	0	0	P_2/P_1	0	……	0
$t+3$	P_2	0	0	0	P_2/P_1	……	0
$t+4$	P_2	0	0	0	0	……	0
$t+T^l$	P_2	0	0	0	0	……	P_2/P_1
$t+T^l+1$	P_2	0	0	0	0	……	0

According to the second-stage problem, the extent of hoarding is a function of tax increases, and the tax increase rate is a good proxy for hoarding. Therefore, each of the seven tax increases is

used to examine the effects of hoarding and storage.

$$\begin{aligned} Q_t = {} & \theta_0 + \theta Q_{t-1} + \beta\theta Q_{t+1} + \theta P_t + \theta_2 e_t + \theta_3 e_{t+1} \\ & + (\Delta\overline{Hoarding}_t + \Delta\overline{Store}1_t + \Delta\overline{Store}2_t + \Delta\overline{Store}3_t) \\ & - \theta(\Delta\overline{Hoarding}_{t-1} + \Delta\overline{Store}1_{t-1} + \Delta\overline{Store}2_{t-1} + \Delta\overline{Store}3_{t-1}) \\ & - \beta\theta(\Delta\overline{Hoarding}_{t+1} + \Delta\overline{Store}1_{t+1} + \Delta\overline{Store}2_{t+1} \\ & + \Delta\overline{Store}3_{t+1}). \end{aligned} \tag{2.19}$$

Since the inventory has the characteristics shown in Figure 2.1, it can be written as,

$$\begin{aligned} \Delta\overline{Hoarding}_t &= -a\Delta\overline{Store}1_{t+1}, \\ &= -b\Delta\overline{Store}2_{t+2}, \\ &= -c\Delta\overline{Store}3_{t+3}, \quad for \;\; 1 < a, b, c. \end{aligned}$$

Therefore, the variables on the right hand side can be written as

$$\begin{aligned} \Delta\overline{Hoarding}_{t-1} &= -a\Delta\overline{Store1}_t, \\ \Delta\overline{Store}1_{t-1} &= (b/a)\Delta\overline{Store}2_t, \\ \Delta\overline{Store}2_{t-1} &= (c/b)\Delta\overline{Store}3_t \\ \Delta\overline{Store}1_{t+1} &= (-1/a)\Delta\overline{Hoarding}_t, \\ \Delta\overline{Store}2_{t+1} &= (a/b)\Delta\overline{Store}1_t, \\ \Delta\overline{Store}3_{t+1} &= (b/c)\Delta\overline{Store}2_t, \end{aligned}$$

then Q_t can be written as

$$\begin{aligned} Q_t = {} & \theta_0 + \theta Q_{t-1} + \beta\theta Q_{t+1} + \theta P_t + \theta_2 e_t + \theta_3 e_{t+1} \\ & + (-\theta)\overline{Hoarding}_{t+1} + (1 + \beta\theta/a)\overline{Hoarding}_t \\ & + (1 + \theta a(1 - \beta/b))\overline{Store}1_t + (1 - \theta b/a - \beta\theta b/c)\overline{Store}2_t \\ & + (1 - \theta c/b)\overline{Store}3_t + (-\theta)\overline{Store}3_{t-1}. \end{aligned} \tag{2.20}$$

Before a price increase, purchases exceed consumption, and hoarding has a positive effect on purchases. Therefore, $\Delta\overline{Hoarding}_{t+1} > 0$ and $\Delta\overline{Hoarding}_t > 0$. Moreover, because $0 < \theta < 1$ and $0 < \beta < 1$, $(-\theta)\Delta\overline{Hoarding}_{t+1} < 0$ and $(1 +$

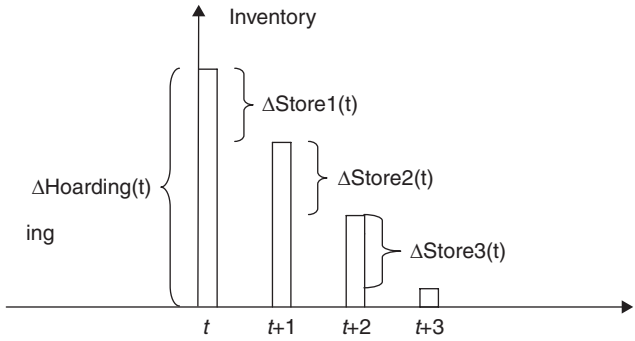


Figure 2.1 Inventory for tax increase in t+1.

$\beta\theta/a)\Delta\overline{Hoarding}_t > 0$. After the price increase, because the inventory must have a negative effect on purchases, $\Delta\overline{Store}1_t < 0$, $\Delta\overline{Store}2_t < 0$, $\Delta\overline{Store}3_t < 0$, and $\Delta Store3_{t-1} < 0$. Therefore, $(1 + \theta a(1 - \beta/b))\Delta\overline{Store}1_t < 0$, $(-\theta)\Delta\overline{Store3}_{t-1} > 0$, and the signs of $(1-\theta b/a-\beta\theta)\Delta\overline{Store}2_t$ and $(1-\theta c/b)\Delta\overline{Store}3_t$ are undetermined.

This purchase equation, Q_t, is estimated in the following section. I have data on the purchases and use the rate of tax increase as proxies for the inventories.

2.3 Empirical Test for the Rational Addiction Model with an Optimal Inventory

2.3.1 Daily Purchases Before and After a Tax Increase

Cigarette prices are controlled by the Japanese government. Cigarette tax increases can be considered a natural experiment for testing the consumer's response to price change. A new cigarette tax increase law was passed on March 4, 2003 and came into effect on July 1, 2003. Daily purchase data for cigarettes in Japan, from April 1, 2003 to September 30, 2003 are shown in Figure 2.2. The horizontal axis shows the purchase date, and the vertical axis shows the daily purchases. In Figure 2.2, there is a big rise in purchases beginning on June 23, about 1 week before the price increase, which peaked on June 30, 2003, 1 day before the price increase. This is the hoarding effect that is due to the tax increase

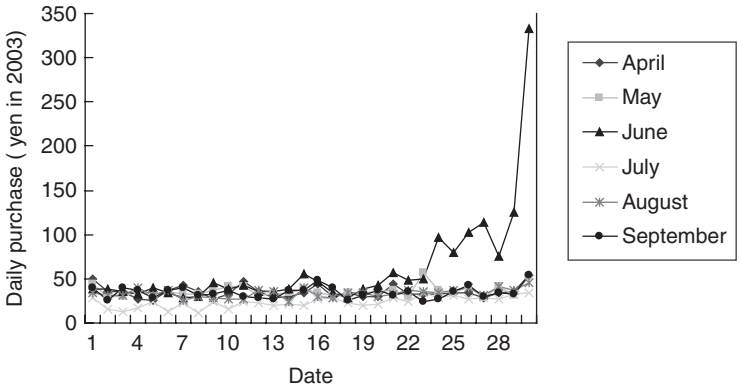


Figure 2.2 Daily purchase before and after tax increase.

Table 2.1 Daily purchase before and after tax increase

	Before tax increase		*After tax increase*	
	Purchase	*Purchase/average*	*Purchase*	*Purchase/average*
8 days	49.34	1.32	10.92	0.29
7 days	97.35	2.60	22.16	0.59
6 days	79.28	2.12	12.54	0.34
5 days	102.87	2.75	24.18	0.65
4 days	113.81	3.04	16.55	0.44
3 days	75.20	2.01	13.24	0.35
2 days	125.26	3.35	15.64	0.42
1 day	332.90	8.89	28.38	0.76

Source: Based on Report of Family Income and Expenditure, 2003.

and it is consistent with the prediction of the theoretical model in the previous section. After the price increase on July 1, 2003, purchases declined. This is the storage effect that is due to hoarding and it is also consistent with the prediction of the theoretical model.

We can compare the daily purchases before and after the tax increase with the average purchases in Table 2.1. The average daily purchase per family was 37.43 yen from April 1, 2003 to September 30, 2003. The purchases on June 30, 2003 were 8.89 times the average daily purchase, and the purchases after the tax increase decreased markedly.

Table 2.2 Monthly purchase frequency and expenditure before and after tax increase

	Frequency (times per 100 family, 1 month)	*Expenditure (yen per family)*
Jan 2003	99	1,098
Feb 2003	96	1,040
Mar 2003	103	1,142
Apr 2003	101	1,107
May 2003	112	1,119
Jun 2003	110	1,884
Jul 2003	79	786
Aug 2003	99	1,089
Sep 2003	96	1,024

Source: Based on Report of Family Income and Expenditure, 2003.

Monthly Purchase Frequency Before and After a Tax Increase

Table 2.2 shows that the frequency of purchases in June 2003, the month just before the tax increase, increased markedly and decreased markedly in July. This is consistent with the prediction of the inventory model.

Monthly Purchases Before and After a Tax Increase

From Table 2.2, and Figures 2.3, 2.4, 2.5, it is clear that the cigarette expenditure per family in June increased markedly, while it decreased markedly in July 2003. This is also consistent with the optimal inventory theory.

2.3.2 Formal Test of the Addiction Model Using Monthly Data

In Japan, cigarette price or tax changes are totally exogenous to the cigarette consumer and can be considered a natural experiment. The exogenous price is suitable for estimating the cigarette purchase or demand equation.

Dataset for an Econometric Model

The following data consist of monthly series from January 1954 to September 2003. The details are shown in Appendix 2B.

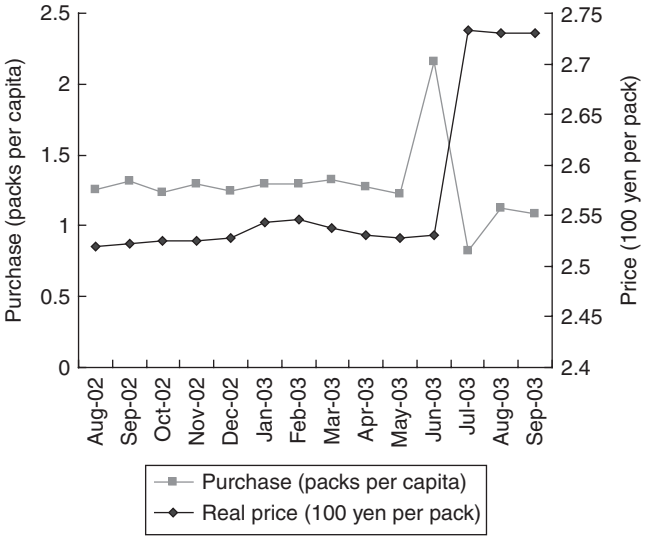


Figure 2.3 Monthly cigarette purchase before and after tax increase in 2003.

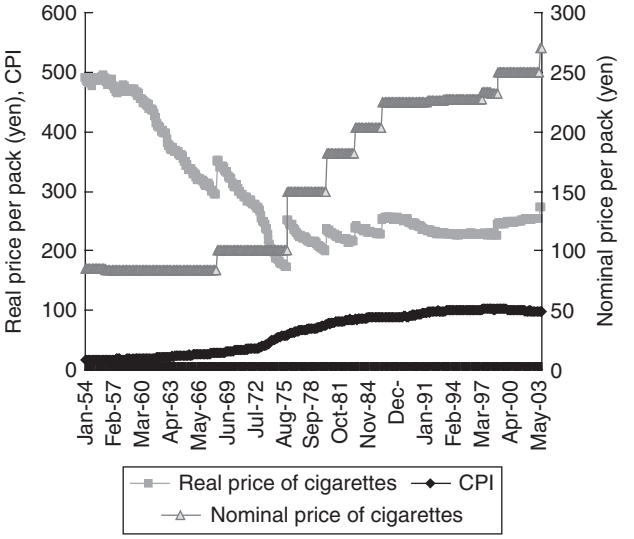


Figure 2.4 Real and nominal cigarette price: January 1954 to September 2003.

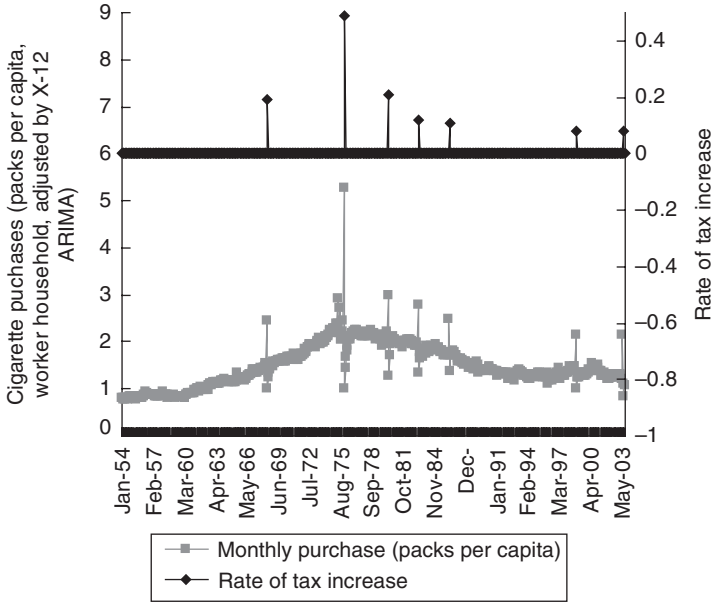


Figure 2.5 Per capita cigarette purchases versus rate of tax increase: January 1954 to September 2003.

(**Cigarette purchases by Japanese worker households**) $\overline{Purchase_t}$ is the monthly total of cigarette purchases, in packs, per capita. The data are taken from the Annual Report of Family Income and Expenditure Survey, and are seasonally adjusted using X-12 ARIMA.

(**Price**) $\overline{Price_t}$ is the real average retail cigarette price per pack in month t. It equals the Tobacco Price Index divided by the CPI. These data are taken from the Annual Report on the Consumer Price Index and the Monthly Report on the Retail Price Survey. It is seasonally adjusted using X-12 ARIMA, and the units are 100 yen, in 1995, per pack.

(**Disposable income**) Y_t is the real monthly worker household disposable income per capita. These data are taken from the Annual Report of Family Income and Expenditure Survey. It equals the total disposable income per family, divided by the total population per family and the CPI. It is seasonally adjusted using X-12 ARIMA and the units are 1,000 yen, in 1995, per capita.

Table 2.3 Summary statistics: January 1954 to September 2003

Variable	*Mean*	*Std. Dev*	*Max.*	*Min.*
Purchase_t	1.475	0.460	5.277	0.769
Price_t	2.912	0.898	4.959	1.715
Y_t	945.854	345.210	1439.970	273.486
ΔY_t	1.721	26.054	108.564	−134.337

(First difference of the disposable income) ΔY_t is the first difference of the monthly disposable income and the units are 1,000 yen, in 1995, per capita.

The summary statistics of these variables are shown in Table 2.3.

Unit Root Tests

If any of the variables are nonstationary, problems can arise from a statistical inference using the ordinary least-squares (OLS) or two-stage least-squares (2SLS) method. Therefore, we test whether each variable is stationary using the augmented Dickey–Fuller (ADF) and Phillips–Perron test. The test results are reported in Table 2.4.

The unit roots of $\overline{Purchase_t}$ with time are rejected at the 1% significance level. The unit roots of $\overline{Price_t}$ are rejected at the 5% significance level. Since the unit roots of Y_t cannot be rejected at any conventional significance level, Y_t is not stationary. Since the unit roots of ΔY_t with time are rejected at the 1%, it is considered stationary over time.

Estimation Technique

OLS and 2SLS are used to obtain the parameter estimates. The OLS estimates may not be consistent estimates because of the endogeneity of past and future consumption (or purchases) and the serial correlation in the residuals. To obtain consistent estimates, 2SLS methods are used.

The 2SLS estimates are consistent using instrument variables. The price of cigarettes is an exogenous variable for the

Table 2.4 Tests of unit roots (ADF test and Phillips-Perron test): January 1954 to September 2003

Variable	*ADF test*				*Phillips-Perron test*			
	Constant	*Time*	*Lag length*	*Test statistics*	*Constant*	*Time*	*Lag length*	*Test statistics*
Purchase_t	Yes	Yes	4	−19.236(***)	Yes	Yes	5	−6.840(***)
Price_t	No	No	4	−2.363(**)	No	No	5	−2.341(**)
Y_t	Yes	Yes	4	−0.174	Yes	Yes	5	−2.059
ΔY_t	Yes	Yes	4	−17.807(***)	Yes	Yes	5	−57.206(***)

Note: ***significant at 1%; **significant at 5%; *significant at 10%.

consumer. Furthermore, the price strongly correlates with cigarette consumption; therefore, it is a good instrument variable for cigarette consumption (or purchases). The lagged prices and taxes are used as instrument variables for past cigarette consumption (or purchases), while the leads of price and taxes are used as instrument variables for future cigarette consumption (or purchases).

According Wu (1973), the Wu test is used to determine whether the OLS estimates are consistent. The overidentification (OID) test is used to test the validity of the overidentifying restrictions.

Estimation Results Without Distinguishing Between Purchases and Consumption

The estimated values are reported in Table 2.5. Since $\overline{Purchase_t}$, $\overline{Price_t}$, and ΔY_t are stationary with time, the time trend is included in the estimation equation. In the OLS column, the results are considered inconsistent estimates because of endogenous explanatory variables. In the 2SLS column, the coefficient of $\overline{Price_t}$ is negative and significant. The coefficients of $\overline{Purchase_{t-1}}$ and $\overline{Purchase_{t+1}}$ are negative and significant. The sign of the estimated coefficients of $\overline{Purchase_{t-1}}$ and $\overline{Purchase_{t+1}}$ does not satisfy the addiction condition. These results appear to be a durability effect.

According to the OID test, the set of instruments is invalid. This means that the instruments correlate with the error term, which causes the problem of sign inversion. Therefore, the influence of

Table 2.5 Estimation results without distinction between purchase and consumption (do not consider optimal inventory)

Independent variable	*OLS*		*2SLS*	
	Coefficient	*T-statistic*	*Coefficient*	*T-statistic*
Constant	2.467 (***)	12.738	7.587 (***)	13.731
Purchase_{t-1}	0.235 (***)	6.194	−0.264 (***)	−3.484
Purchase_{t+1}	0.177 (***)	4.394	−0.572 (***)	−5.800
Price_t	−0.415 (***)	−12.163	−1.268 (***)	−13.542
ΔY_t	0.000	−1.181	0.000	−0.206
Time	−0.001 (***)	−10.445	−0.004 (***)	−12.836
Adjusted R-square	0.787			0.539
OID ratio				92.508
Wu ratio				100.510
Observations		593		593

Note: ***significant at 1%; **significant at 5%; *significant at 10%.
The instruments of the 2SLS Column: two lags and two leads of price, hoarding dummy, store dummy, and other explanatory variables; the critical 5% value for Chi-square distribution with 4 degrees of freedom (OID test) is 9.488; the critical 5% value for Chi-square distribution with 6 degrees of freedom (Wu test) is 12.592.
2SLS, two-stage least squares; OID, overidentification test; OLS, ordinary least squares.

the inventory is very serious. If it is ignored, consistent estimates cannot be obtained.

Estimation Results Distinguishing Between Purchases and Consumption

The results are reported in Table 2.6. Since $\overline{Purchase_t}$, $\overline{Price_t}$, and ΔY_t are stationary over time, the time trend is included in the estimation equation. The set of instruments in the 2SLS is valid, according to the OID test. The hypothesis that the OLS estimates are consistent can be rejected at the 5% level using the Wu test. Therefore, the 2SLS estimates are consistent.

In the 2SLS column, the coefficient of $\overline{Price_t}$ is negative and significant. The coefficients of $\overline{Purchase_{t-1}}$ and $\overline{Purchase_{t+1}}$ are negative and significant. The sign of the estimated coefficients of $\overline{Purchase_{t-1}}$ and $\overline{Purchase_{t+1}}$ satisfies the addiction condition. The estimated values also satisfy the stability conditions.

Table 2.6 Estimation results with distinction between purchase and consumption (consider optimal inventory, rational addiction model with optimal inventory)

Independent variable	*OLS*		*2SLS*	
	Coefficient	*T-statistic*	*Coefficient*	*T-statistic*
Constant	0.277	(3.511)***	0.663	(1.722)*
Purchase_{t-1}	0.469	(13.609)***	0.492	(3.898)***
Purchase_{t+1}	0.463	(13.306)***	0.343	(2.834)***
Price_t	−0.046	(−3.371)***	−0.110	(−1.712)*
ΔY_t	0.000	(−0.334)	0.000	(−0.578)
Hoarding_{t+1}	−2.546	(−10.656)***	−1.841	(−2.546)**
Hoarding_t	7.222	(43.749)***	6.868	(17.196)***
Store_1_t	−4.898	(−16.986)***	−5.044	(−5.366)***
Store_2_t	0.307	(2.235)**	0.317	(1.223)
Store_3_t	0.165	(1.308)	0.207	(1.336)
Store_3_t	0.056	(0.449)	0.099	(0.755)
Time	0.000	(−2.949)***	0.000	(−1.685)*
$\theta^2\beta<1$		(−3.810)***		(−1.924)***
$\varphi 1 < 1$		(−5.146)***		(−3.047)***
$\varphi 1 > 1$		(3.533)***		(1.351)*
Short-run ε	−0.414	(−4.464)***	−0.489	(−2.147)**
Long-run ε	−1.325	(−8.278)***	−1.311	(−19.074)***
Adjusted R-square	0.975		0.974	
OID ratio			19.162	
Wu ratio			23.934	
Observations	593		586	

Note: ***significant at 1%; **significant at 5%; *significant at 10%.
The instruments of the 2SLS Column: four lags and one lead of price, seven lags of ΔY, three leads of hoarding dummy, five lags of store dummy, and other explanatory variables; The critical 5% value for Chi-square distribution with 14 degrees of freedom (OID test) is 23.685. The critical 5% value for Chi-square distribution with 12 degrees of freedom (Wu test) is 21.026.
2SLS, two-stage least squares; OID, overidentification test; OLS, ordinary least squares.

The coefficients of $\overline{Store2}_t$, $\overline{Store3}_t$, and $\overline{Store3}_{t-1}$ are not significant. The coefficients of $\overline{Hoarding}_{t+1}$, $\overline{Hoarding}_t$, and $\overline{Store1}_t$ are significantly negative, positive, and negative, respectively. These results are consistent with the predictions of the RA model with an optimal inventory.

Therefore, the model is strongly supported by Japanese monthly purchases. I use the estimated coefficients and sample means in

Table 2.7 Hoarding size versus the rate of tax increase

Events of tax increase	*Purchase (2 months before tax increase)*	*Purchase (1 month before tax increase*	*Hoarding*	*Rate of tax increase*
1	1.472	2.453	0.981	0.188
2	2.447	5.277	2.83	0.491
3	2.153	2.988	0.835	0.211
4	1.914	2.772	0.858	0.119
5	1.71	2.484	0.774	0.111
6	1.464	2.138	0.674	0.078
7	1.224	2.154	0.93	0.08
Average	1.769	2.895	1.126	0.183

Source: Based on Report of Family Income and Expenditure, 1954–2003.

Table 2.3 to estimate the short- and long-run price elasticity shown in the rows "$\overline{short} - \overline{run}\ \epsilon''$ and "$\overline{long} - \overline{run}\ \epsilon,''$ respectively. The long-run price elasticity is about 2.681 times greater than the short-run value.[3]

The Amount of Hoarding Versus the Rate of Tax Increase

The amount of hoarding before every tax increase is calculated. According to the prediction of the theoretical model, the amount of hoarding equals the purchase difference between the 2 months just before the tax increase, if consumption in those 2 months is unchanged. The result is presented in Table 2.7. The amount of hoarding increases with the rate of the tax increase.

$$\begin{aligned}
&\overline{Tax\ elasticity\ of\ hoarding} \\
&= \frac{\overline{Average\ hoarding}/\overline{Average\ purchase}}{\overline{Average\ rate\ of\ tax\ increase}} \times 100\%, \\
&= \frac{1.126/1.475}{0.183} \times 100\%, \\
&= 418.067\%.
\end{aligned}$$

The tax elasticity of hoarding is astonishingly large. This implies that the consumer will hoard more than four times as much as the average purchase if the tax rate increases 100%.

2.4 Conclusion

This chapter presents an approach that distinguishes between purchases and consumption. Future price information is used to distinguish between purchases and consumption. If a rational consumer has information on a future price decrease, she will not hoard cigarettes, and the purchase of cigarettes can be considered as her consumption. However, if that rational consumer has information on a future price increase, she will hoard cigarettes just before the price increase because cigarettes have a "pull-date." Therefore, purchases exceed consumption. The rate of tax increase is used as a proxy variable for hoarding and stock to express the consumer response to price information.

Since the Japanese government has total control of the price of cigarettes, the price is completely exogenous to the cigarette consumer and can be considered a natural experiment. The price of cigarettes is suitable for testing the consumer's response to a price change in terms of purchases and consumption.

The effect of hoarding and stock is astonishingly large. The tax elasticity of hoarding cigarettes exceeds 400%. If the hoarding and stock effects are not considered, the problem of sign inversion (the addiction effect becomes the durability effect) will arise and consistent estimators will not be obtained. This occurs because the price or tax correlates with the error term when the consumer's optimal inventory behavior is not considered.

The RA model with an optimal inventory is strongly supported by monthly household data for Japanese workers. The consumer responds to information about a price increase by hoarding cigarettes and reducing consumption.

Japan has experienced low deflation, although there have been many efforts to stimulate the economy. There are no valid policies for stopping deflation and stimulating a flat economy. Since consumer purchases become very large just before a tax increase, due to hoarding, a tax increase could be used as a valid temporary policy to stimulate the economy and halt deflation.[4]

The consumer's response to health information has not yet been analyzed.[5] It will be analyzed in the next 2 chapters.

Appendix 2A: Proofs for Propositions 2.1 and 2.2

Proof for Proposition 2.1

$P_1 < P_2 = P_3 = \ldots = P_{T^l}$ is assumed to simplify the proof.

When $t = T^l$, according to (2.14),

$$\begin{aligned} \mu_{T^l} &= (1+r)^{-T^l} P_{T^l} - \gamma_{T^l}, \\ I_{T^l} = 0, \rightarrow \lambda_{T^l} &> 0 \ (\overline{Kuhn - Tucker's\ condition}), \\ \overline{then},\ Q_{T^l} &= -I_{T^l-1} + C_{T^l}. \end{aligned} \tag{2.21}$$

According to (2.16),

$$\begin{aligned} \lambda_{T^l} &= (1+r)^{-T^l} F'(I_{T^l}) + (1+r)^{-T^l} P_{T^l} - \gamma_{T^l}, \\ &= (1+r)^{-T^l} P_{T^l} - \gamma_{T^l} > 0 \ (\overline{Kuhn - Tucker's\ condition}), \\ \overline{then}\ \gamma_{T^l} &< (1+r)^{-T^l} P_{T^l}. \\ Q_{T^l} &> 0, \ \overline{for}\ \gamma_{T^l} = 0. \\ Q_{T^l} &= 0, \ \overline{for}\ 0 < \gamma_{T^l} < (1+r)^{-T^l} P_{T^l}. \end{aligned}$$

Similarly, when $t = n$, $(1 < n < T^l)$, according to (2.14) and (2.15),

$$\begin{aligned} \mu_n &= (1+r)^{-n} P_n - \gamma_n, \\ \lambda_n &= (1+r)^{-n} F'(I_n) + \mu_n - \mu_{n+1} \\ &= (1+r)^{-n} F'(I_n) + (1+r)^{-n} P_n - (1+r)^{-n-1} P_{n+1} - \gamma_n + \gamma_{n+1}. \\ (1+r)^{-n} F'(I_n) I_{T^l} &\geq 0 \ \overline{and}\ \gamma_{n+1} \geq 0, \\ \overline{if}\ P_n = P_{n+1}\ \overline{and}\ \gamma_n &= 0, \ \overline{then}\ Q_n = 0 \\ \overline{and}\ \lambda_n &> 0, \ I_n = 0, \\ \overline{if}\ P_n = P_{n+1}\ \overline{and}\ \gamma_n &> 0, \ \overline{then}\ Q_n > 0 \\ \overline{and}\ \lambda_n &= 0, \ I_n > 0. \end{aligned} \tag{2.22}$$

Proof for Proposition 2.2

Similarly, when $t = 1$, $(1 < n < T^l)$, according to (2.14) and (2.15),

$$\mu_1 = (1+r)^{-1} P_1 - \gamma_1 = (1+r)^{-1} P_1,$$

$$\lambda_1 = (1+r)^{-1}F'(I_1) + (1+r)^{-1}P_1 - (1+r)^{-2}P_2 + \gamma_2.$$

$$\overline{if}\ 1 < P_2/P_1 \leq (1+r),\ \overline{then}\ \lambda_1 > 0\ \overline{and}\ I_1 = 0,\ Q_1 = C_1.$$

$$\overline{if}\ (1+r) < P_2/P_1,\ \overline{then}\ \lambda_1 = 0\ \overline{and}\ I_1 > 0,\ Q_1 = C_1 + I_1.$$

$$\overline{and}\ I_1\ \overline{is\ the\ function\ of}\ P_2/P_1,\ F(I_1),\ \overline{and}\ T^l,$$

$$0 \leq I_1^* \leq \sum_{t=2}^{T^l} C_t. \quad (2.23)$$

Appendix 2B: Data

Consumer Price Index: Statistics Bureau Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan. *Annual Report on the Consumer Price Index*, 1951–1999.

Consumer Price Index of Cigarettes: Statistics Bureau Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan. "Subgroup index for Japan." *Annual Report on the Consumer Price Index*, 1951–1999.

Nominal Worker Household Disposable Income: Economic Planning Agency, Government of Japan. *Annual Report of Family Income and Expenditure*, 1951–1999.

Nominal Retail Cigarette Price: Statistics Bureau Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan. "Nationwide uniform prices or charges," *Monthly Report on the Retail Price Survey*, 2000.

Nominal Tax Revenues: Ministry of Finance, Government of Japan. *Public Finance Statistics*, 1951–1999.

Normal Cigarette Price: Nominal Retail Cigarette Price (1999) times consumer price index of cigarettes divided by the index (1999).

Per Capital Worker Household Cigarette Consumption: Per worker household total cigarette consumption expenditure divided by per household population.

Real Household Disposable Income: Nominal Household Disposable Income divided by the consumer price index.

3

Response to Health Information: Theory and Evidence from Cigarette Consumption and Intake of Nicotine and Tar in Japan

3.1 Introduction

Smoking is a complicated behavior. It is influenced not only by price, income, and past and future cigarette consumption, but also by many other factors such as health information because it is addictive and harmful to one's health. Therefore, it is very important to clarify how the cigarette consumer responds to health information.

I introduce health information into the RA model. It is shown that a consumer overconsumes cigarettes because of a lack of awareness of health hazard information and reduces consumption in response to new information. Precisely because smoking is addictive and harmful to one's health, the Japanese government has implemented many tobacco control policies. I use policy information and Japanese monthly data to test the rational addiction model with health information. The model is strongly supported.

Until now there have been many studies that analyze the consumption of hazardous goods such as cigarettes. Ippolito (1981) developed a theoretical model to analyze consumer reaction to new health information. Ippolito and Ippolito (1984) provided empirical evidence that new health information reduces cigarette consumption. Goldbaum (2000) developed a model that analyzed

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

the consumption path of harmful addictive goods in the continuous time case and concluded that the endogenous desire to quit smoking can result from a rational consumption path chosen as the consumer begins smoking. Viscusi (1992) and Hu et al. (1995) also reported that health hazard information had a strong effect on a consumer's behavior. Clark and Etile (2002) find those whose health worsens when smoking smoke less in the future and are more likely to quit using British panel data. But the above articles do not analyze the impact of health hazard information in the context of RA. Here, a testable RA model with health information will be constructed and tested by Japanese policy events and monthly data.

Auld and Grootendorst (2004) point that the estimable RA model tends to yield spurious evidence when aggregate data are used; if, however, prices are exogenous, instrumental variable estimates of the coefficients on the lag and lead of consumption will be consistent. Cigarette consumption in Japan is just the exceptional case. The cigarette price is considered exogenous because it is not determined by the cigarette firms but totally by the Japanese central government.

There are two articles on cigarette consumption in Japan. One is Haden's (1990) which is not concerned with addiction and health hazard information. The other is Yorozu and Zhou's (2002) who present a theoretical model of cigarette demand and estimate the model using Japanese prefecture-level data. But there are a few points that need improvement in Yorozu and Zhou (2002). First, the information measure used is prefectural antismoking budget dummies that are collected over the telephone from prefectural officials. This budget may be used not only for information dissemination but also for other purposes, for example, the construction of smoking areas (because of smoking ban), etc. Second, the addictive aspect of smoking is ignored, and thus, there is a specification error in the cigarette demand model. These two points are improved upon in this chapter.

The effects of antismoking policies (e.g., workplace smoking bans) have been analyzed by Evans et al. (1999) and Bardsley and Olekalns (1999), whose results support the view that workplace smoking bans reduce smoking. Wan (2004d) analyzes the effects

of Japanese antismoking policies using annual data and finds that their effects are not statistically significant.[1] Can these effects be observed when monthly data are used? Wan (2004e) examines the effects of mandatory information disclosure on interbrand cigarette demands using cigarette brand sales data and finds that the mandatory disclosure of nicotine and tar information decreased the demand of high nicotine and tar brands. Can I confirm these effects by time-series data?

This chapter is organized as follows: The conceptual framework is described in Section 3.2. Events of tobacco control are outlined in Section 3.3. The data and empirical strategy are presented in Section 3.4. The empirical results are reported in Section 3.5. Conclusions are presented in Section 3.6.

3.2 Conceptual Framework

As described in Stigler and Becker (1977), "A consumer may indirectly receive utility from a market good, yet the utility depends not only on the quantity of the good, but also the consumer's knowledge of its true or alleged properties. If he does not know whether the berries are poisonous, they are not food, if he does not know that they contain vitamin C, they are not consumed to prevent scurvy." The consumer derives utility from a good based on his limited knowledge about it, where knowledge is produced by scientific research and is thus exogenous to the consumer. This idea will be introduced into the Becker et al. (1994) model. A cigarette demand function with health hazard information will be derived.

Consumers are assumed to be infinite-lived and to maximize lifetime utility discounted at the rate r. Utility is composed of two parts – one is euphoria from smoking and the other is the disutility from knowing the health hazard. Consumption euphoria and the disutility of the health hazard are assumed to be separable. The consumer's utility is bounded by his or her limited information.

$$V(C_t, C_{t-1}, Y_t, e_t; I_t) = U(C_t, C_{t-1}, Y_t, e_t) - \alpha(I_t)C_t. \tag{3.1}$$

The consumer's problem is

$$\max \sum_{t=1}^{\infty} \beta^{t-1} \left[U(C_t, C_{t-1}, Y_t, e_t) - \alpha(I_t) C_t \right],$$

$$\overline{s.t.} \sum_{t=1}^{\infty} \beta^{t-1} (Y_t + P_t C_t) = A^0, \tag{3.2}$$

$$\beta = 1/(1+r).$$

Here C_t, C_{t-1} are the quantities of cigarettes consumed in periods t and $t-1$, respectively. Y_t is the consumption of the composite commodity in period t, and e_t reflects the impact of unmeasured life cycle variables on utility. The composite commodity, Y, is taken as the numeraire, and thus the price of cigarettes in period t is denoted by P_t. The rate of interest is assumed to equal the rate of time preference. β is the time discount factor. Any effect of C on earnings and on the present value of wealth (A^0) is ignored. The same applies to the effect of C on other types of uncertainty. The initial condition for the consumer in period 1, C^0, measures the level of cigarette consumption in the period prior to the one under consideration.

$\alpha(I_t)$ is the consumer's disutility factor which is his subjective belief that smoking is really harmful to his health. This subjective belief is assumed to increase with *information* by Bayesian leaning framework; thus $\frac{d\alpha(I_t)}{dI_t} > 0$. It is assumed to be zero if the consumer has no health hazard information; in other words, $\alpha(0) = 0$.[2] New beliefs will be formed when new health hazard information is announced.

The associated first-order conditions are

$$U_y(C_t, C_{t-1}, Y_t, e_t) = \lambda, \tag{3.3}$$

$$U_1(C_t, C_{t-1}, Y_t, e_t) + \beta U_2(C_{t+1}, C_t, Y_{t+1}, e_{t+1}) - \alpha(I_t) = \lambda P_t. \tag{3.4}$$

A consumption euphoria function that is quadratic in Y_t, C_t, and e_t is considered. By solving the first-order condition for Y_t and substituting it into the first-order condition for C_t, a linear difference equation can be derived:

$$C_t = \theta_0 + \theta C_{t-1} + \beta\theta C_{t+1} + \theta_1 P_t + \eta(I_t) + \theta_2 e_t + \theta_3 e_{t+1}, \tag{3.5}$$

where[3]

$$\eta(I_t) = \frac{u_{yy}\alpha(I_t)}{(u_{11}u_{yy} - u_{1y}^2) + \beta(u_{22}u_{yy} - u_{2y}^2)}.$$

Health hazard information cannot be anticipated by the consumer. If the consumer obtains new health hazard information at time t, the short-run effect of health hazard information is

$$\frac{dC_t}{dI^*} = \frac{1}{\theta(1-\phi_1)\phi_2}\frac{d\eta(I_t)}{dI_t} < 0,$$

which is defined as the impact of an increase in current and all future information on current consumption, with past consumption being held constant.

If there is no information depreciation, the long-run effect of health hazard information is

$$\frac{dC_\infty}{dI} = \frac{1}{\theta(1-\phi_1)(\phi_2 - 1)}\frac{d\eta(I_t)}{dI_t} < 0,$$

which is defined as the effect of a permanent increase in information in all periods. $|\frac{dC_\infty}{dI}| > |\frac{dC_t}{dI^*}|$, meaning that the absolute value of the long-run effect is larger than the short-run one. True information on smoking damage can be called $I_{\overline{max}}$. If the information I received by the consumer is smaller than $I_{\overline{max}}$, the consumer will overconsume cigarettes. $C(I) > C(I_{\overline{max}})$ $\overline{for}$ $I_{\overline{max}} > I$.

3.3 Events

There were ten main events of tobacco control during the 1951–1999 period, according to Report on Smoking and Health by Minstry of Health and Welfare of Japan (1987, 1993). They are shown in Table 3.1. How did consumers respond to these events? Have they effectively contributed toward reducing cigarette consumption? Dummy variables were constructed from the information shown in Table 3.1 and included in our econometric model.

There were six events of tobacco tax increases. They are shown in Wan (2004a). To control for hoarding just before tax increases, dummy variables relating to the tax increases were used in the following econometric analysis.

Table 3.1 Main events of tobacco control from 1951 to 1999

Date	*Events of tobacco control*
April 1967	Information on nicotine and tar content was released
August 1972	Cigarette firms were required to include the following warning on all cigarettes sold: "Let's be careful about smoking too much for health reasons."
April 1978	Ministry of Health and Welfare issued an edict requiring national hospitals and national sanitoriums under its jurisdiction to restrict smoking to certain areas
June 1978	Nonsmoking sections were prepared in the airplane of domestic line
July 1978	Nonsmoking sections were prepared in the ferry of Japan Railway connection
April 1985	Japan Tobacco and Salt Public Corporation was privatized and reorganized into Japan Tobacco Inc.
April 1986	Smoking Research Foundation was established
October 1987	Ministry of Health and Welfare's "Report on smoking and health," 1st edn, was released
January 1990	Cigarette firms were required to include the following warning on all cigarettes sold: "Let's be careful about smoking too much because threre is a possibility it will ruin your health."
May 1993	Ministry of Health and Welfare's "Report on smoking and health," 2nd edn, was released

Source: Asahi Shimbun, 1951–1999.

3.4 Dataset and Empirical Strategy

3.4.1 Dataset Used in Econometric Analysis

All of the data used consist of monthly time series from January 1951 to October 1999. They are described in detail in Appendix 3A. Table 3.2 presents means, standard deviations, and other descriptive statistics for the variables (after seasonal adjustment) in the data set.

3.4.2 Empirical Strategy

Unit Root Tests

If any of variables are not stationary, some problems of statistical inference would arise if OLS or generalized methods of moments (GMM) were used. Therefore, we test whether each variable is

Table 3.2 Summary statistics: January 1951 to October 1999

Variable	*Mean*	*Std. Dev.*	*Max.*	*Min.*
C_t	1.447	1.074	5.225	0.688
$\overline{Nicotine\ intake_t}$	24.667	9.962	70.636	6.799
$\overline{Tar\ intake_t}$	313.292	122.064	926.927	80.109
P_t	3.104	1.097	6.942	1.720
Y_t	8.724	3.658	14.428	1.904
ΔY_t	0.020	0.231	1.135	−1.375
$\overline{Tax_t}$	0.002	0.025	0.491	0.000

Note: Max: maximum value; Min: minimum value; C_t is denominated in number of packs; P_t is denominated in units of 100 yen per pack. Y_t is denominated in units of 100 thousand yen. $\overline{Tax_t}$ is the rate of tax increase, which is not seasonally adjusted.

Table 3.3 Unit root tests (ADF and Phillips–Perron): January 1951 to October 1999

Variable	*ADF test*		*Phillips–Perron test*	
	Lag length	*Test statistics*	*Lag length*	*Test statistics*
C_t	1	−4.094***	5	−5.692***
$\overline{Nicotine\ intake_t}$	2	−3.941**	5	−7.305***
$\overline{Tar\ intake_t}$	2	−3.708**	5	−6.727***
P_t	2	−4.040***	5	−4.967***
Y_t	5	−2.249	5	−1.677
ΔY_t	5	−14.667***	5	−57.119***
$\overline{Tax_t}$	4	−10.956***	5	−24.318***

Note: ***significant at 1%; **significant at 5%; *significant at 10%. The ADF and Phillips–Perron tests for unit roots are in levels. No trend but an intercept is included in the test equation of C_t, P_t, Y_t, ΔY_t and $\overline{Tax_t}$. Time trend and intercept are included in the test equation of $\overline{Nicotine\ intake?_t}$ and $\overline{Tar\ intake_t}$.

stationary. The ADF test and Phllips–Perron test (1988) are used (see Table 3.3).

The null hypothesis that C_t, P_t, ΔY_t, and $\overline{Tax_t}$ have unit roots are rejected the 1% significance level, so these variables are considered to be stationary. Since the null hypothesis that Y_t has a unit root cannot be rejected at any conventional significance level, Y_t is not stationary. When Y_t is included and OLS and GMM are used, a bias may arise, thus I use ΔY_t. $\overline{Nicotine\ intake_t}$

and $\overline{Tar\ intake_t}$ are stationary with time trend; thus, a time trend should be included in the estimation equation.

Estimation Technique

OLS and GMM are used to obtain parameter estimates. OLS is used to estimate the nonaddiction model. Because there is serial correlation in the residuals, AR(1) model is used to estimate the nonaddiction model. In the case of the addiction model, the OLS estimates may not be consistent because of the endogeneity of past and future consumption and because of the possibility that the use of leads and lags gives rise to serial correlation in the residuals. To obtain consistent estimates, I use GMM.

The GMM estimates will be consistent if instrument variables are used. Cigarette prices are totally controlled by the Japanese government, so they are exogenous from the point of view of consumers. Furthermore, since prices are strongly correlated with consumption, they are thought to be good instrument variables for consumption. The lagged cigarette price is used as an instrument variable for past cigarette consumption, while the lead of price is used as an instrument variable for future cigarette consumption. The leads and lags of the rate of tobacco tax increase are also included as additional instruments. Hansen's (1982) J test of the overidentifying restrictions implied by the instruments is used as a portmanteau specification test of the model.

To obtain consistent estimates, hoarding and stock proxies are used to distinguish purchases from consumption following Wan (2004a).

3.5 Results

3.5.1 Cigarette Consumption

Results from Estimation

The parameter estimates of the RA model are reported in Table 3.4. The nonaddiction model (Model 1) is estimated by OLS. The RA models (Models 2 and 3) are estimated using GMM.

In the columns for Models 2 and 3, the coefficients of C_{t-1}, C_{t+1} are positive and significant. The coefficient of P_t is negative and

Table 3.4 Estimates of rational addiction model with health information, Dependent variable = C_t, with distinction between purchase and consumption: January 1951 to October 1999

Independent variable	*Model 1*		*Model 2*		*Model 3*	
	Coefficient	*T-Statistic*	*Coefficient*	*T-Statistic*	*Coefficient*	*T-Statistic*
Constant	2.515	(16.126)***	0.959	(9.597)***	0.870	(7.871)***
C_{t-1}			0.508	(16.870)***	0.517	(18.357)***
C_{t+1}			0.022	(1.694)*	0.024	(1.966)***
P_t	−0.347	(−10.287)***	−0.115	(−7.060)***	−0.098	(−5.115)***
ΔY_t	0.001	(0.148)	0.000	(0.038)	0.000	(−0.024)
US_Report	−0.038	(−0.693)			0.026	(1.289)
Dummy7504	0.569	(10.428)***	0.210	(12.573)***	0.215	(12.505)***
Dummy7509	0.094	(1.516)	0.033	(1.692)*	0.04	(1.944)*
Nicotine-tar	0.161	(3.170)***	0.148	(6.723)***	0.142	(6.369)***
Warning1	0.159	(3.180)***	0.138	(4.762)***	0.147	(4.660)***
Workplace	−0.101	(−2.455)**	−0.069	(−3.414)***	−0.068	(−3.370)***
Research	−0.135	(−2.566)**	−0.104	(−3.410)***	−0.107	(−3.536)***
Report1	−0.192	(−3.430)***	−0.1	(−2.793)***	-0.095	(-2.713)***
Warning2	−0.193	(−3.673)***	−0.079	(−3.371)***	−0.075	(−3.336)***
Report2	−0.061	(−1.304)	−0.025	(−1.505)	−0.024	(−1.500)
Hoarding	6.207	(49.756)***	5.946	(32.051)***	6.011	(33.187)***
Stock	−1.618	(−14.194)***	−5.514	(−28.693)***	−5.585	(−29.948)***
$4\theta^2\beta$-1<0				(−34.670)***		(−35.742)***
$\varphi_1 - 1 < 0$				(−74.721)***		(−77.741)***
$\varphi_2 - 1 > 0$				(7.659)***		(8.163)***
Short-run ε	−0.745	(−10.286)***	−0.255	(−7.540)***	−0.218	(−5.296)***
Long-run ε	−0.745	(−10.286)***	−0.524	(−10.520)***	−0.458	(−6.379)***
Adjusted R^2	0.978		0.978		0.978	
D–W Statistic	2.296		1.984		1.982	
J-Statistic			0.009		0.01	
Observations	583		580		580	

Note: *** significant at 1%; ** significant at 5%; * significant at 10%.
The instruments of Models 2 and 3: three lags and three leads of price, two lags and two leads of tax rate, other explanatory variables;*p*A¦values for the *J*-test of Models 2 and 3 are 1, respectively.
Asymptotic *t* statistics are in parentheses.

significant. The estimated values satisfy the stability conditions. Thus, these results soundly support the RA model. The coefficient of ΔY_t is not significant in Model 2; also, it is not significant in Model 3. The coefficient of $\overline{US\ Report}$ is positive but not significant. The coefficients of $\overline{Nicotine-tar}$ and $\overline{Warning1}$ are positive and significant. It appears that the consumer maintains or increases her consumption of cigarettes but shifts to low nicotine and tar types of cigarettes after information on nicotine and tar is disclosed because the total intake of nicotine and tar decreased

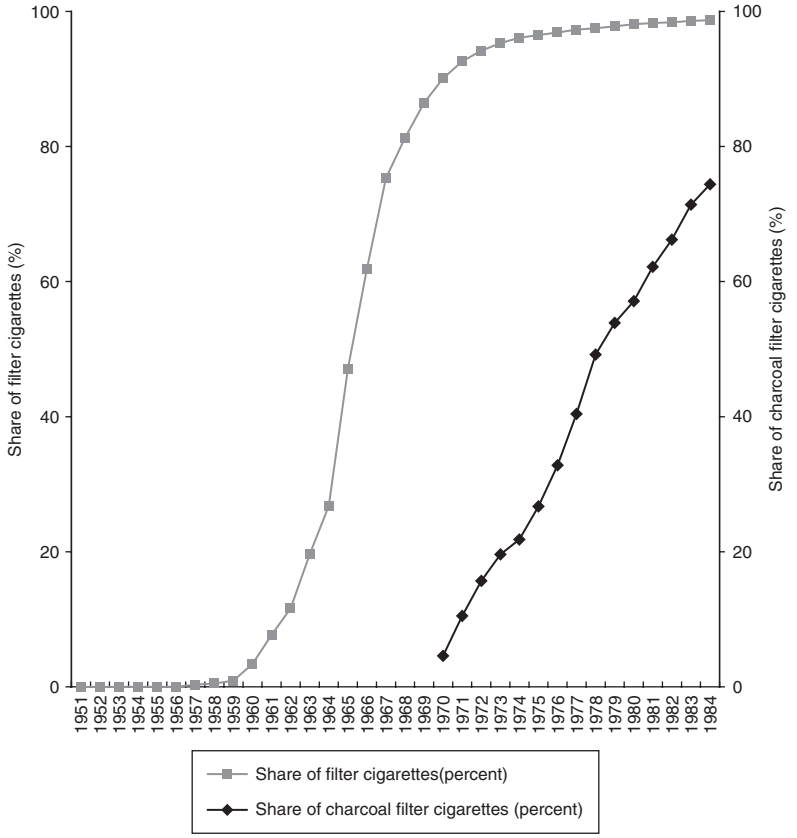


Figure 3.1 Share of filter cigarettes: 1951–1984; charcoal filter cigarettes: 1970–1984.

significantly. This is clarified in the next subsection Nicotine and Tar Intake. See the Figures 3.1, 3.2, 3.3 and the results in Table 3.5.

The coefficient of $\overline{Workplace}$ is negative and significant. Thus, the policy of a smoking ban was effective. This result is different from the results based on annual data. The coefficient of $\overline{Research}$ is negative and significant. Thus, cigarette research has a negative effect on cigarette consumption, as expected.

The coefficients of $\overline{Report}1$ and $\overline{Warning}2$ are negative and significant. This result can be interpreted as follows: the consumer decreases the consumption in response to the disclosure of damage information. According to Figures 3.2 and 3.3, average nicotine

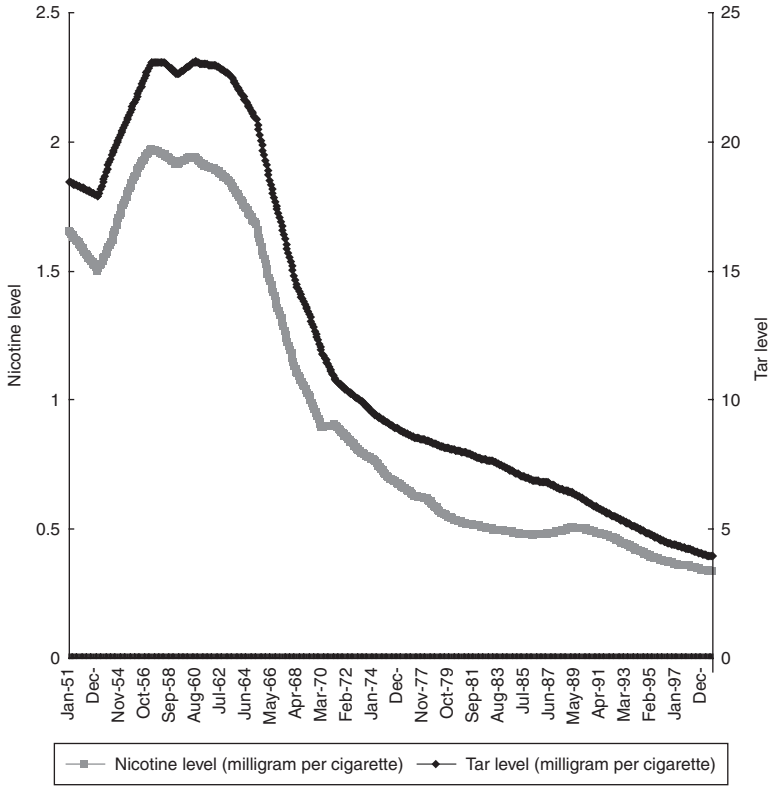


Figure 3.2 Nicotine and tar intake levels: 1951–1999.

and tar per cigarette declined only slightly and was very stable after the 1980s. The consumer had to reduce consumption in order to adjust the stock of nicotine and tar gradually in response to new health hazard information. This behavior is also consistent with RA behavior. The coefficient of $\overline{Report}2$ is negative, as expected, but not significant.

The coefficient of $\overline{Hoarding}$ is positive, significant, and large, while the coefficient of $\overline{Stock}$ is negative, significant, and large. Thus, the consumer hoarded many cigarettes just before the price increase taking account of future price information. This result is very close to the one in Wan (2004a).

In the RA model, consumption depends on past and future consumption; thus, it changes only gradually. There is a possibility that the RA model makes it difficult for the consumers to respond

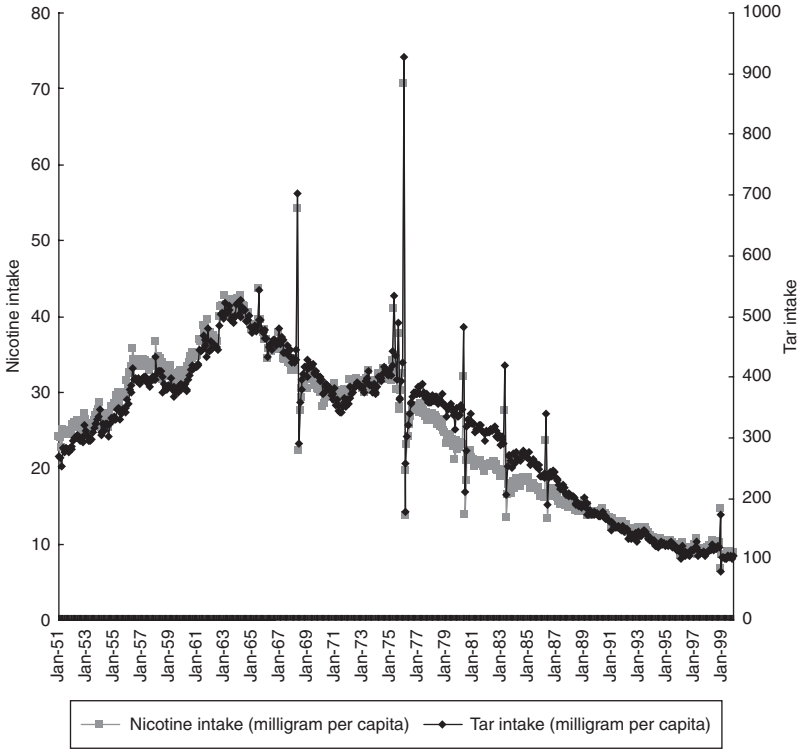


Figure 3.3 Nicotine and tar intake levels: 1951–1999.

in a timely manner to health information. I also tried estimating a standard model (Model 1), but its results were very close to those of the RA model. The consumers' responses to information on price and health suggest that he or she is very rational.

I also use the estimated coefficients and sample means in Table 3.2 to estimate the short- and long-run price elasticities,[4] which are shown in the rows labeled "short-run ϵ" and "long-run ϵ." The long-run price elasticity is about 2.055 times as large as the short-run price elasticity and is close to the estimate based on annual data.[5]

The value of β implied by the results in Table 3.4 is too small. It is considered difficult to estimate β precisely using a specific good. Here I impose the discount factor a priori to estimate the RA model (Model 2) again. The long-run price elasticities are reported in Table 3.6. The results in Table 3.6 are stable when

Table 3.5 Robustness test, impose β a priori (Model 2)

β	0.950	0.900	0.800	0.700	0.600	0.500	0.400
$long-run\ \epsilon$	0.564	0.572	0.557	0.548	0.556	0.550	0.551

Note: $\overline{Long-run}\ \epsilon$ calculated by GMM estimators. GMM, generalized methods of moments.

Table 3.6 Rate of contribution of each factor

Factor	*January 1951 to March 1975 (%)*	*April 1975 to October 1999 (%)*
$\Delta P/P$	57.4	28.9
Nicotine and tar	17.4	
*Warning*1	16.2	
Workplace ban		12.4
Research		19.6
*Report*1		17.4
*Warning*2		13.6
Other factors	9.0	8.1
Total	100	100

β is changed from 0.4 to 0.95 and are very close to those of Model 2 in Table 3.4.

Rate of Contribution of Each Factor

Cigarette purchases data showed an upward tendency during the January 1951 to March 1975 period, but showed a downward trend during the April 1975 to October 1999 period. Thus, I divide the full period into two subperiods and estimate the cigarette demand model separately.[6] The coefficient of Y_t is significantly positive during the January 1951 to March 1975 period but is significantly negative during the April 1975 to October 1999 period. The various estimates are used to calculate the rate of contribution of each factor. The rate of contribution of price, income, and other factors are shown in Table 3.7.

About 57.4% of the increase in cigarette consumption during the January 1951 to March 1975 period can be explained by the decline in real price, about 17.4% by the disclosure of nicotine and tar content, about 16.2% by Warning1 and about 9.0% by other factors.

Table 3.7 Estimates of intake of nicotine and tar with health information, Dependent variable = nicotine intake, tar intake, with distinction between purchase and consumption: January 1951 to October 1999

Independent Variable	*Nicotine intake*		*Tar intake*	
	Coefficient	*T-statistic*	*Coefficient*	*T-statistic*
Constant	79.845	(17.396)***	983.663	(17.564)***
P_t	−8.948	(−9.881)***	−111.990	(−10.099)***
ΔY_t	0.018	(0.146)	0.384	(0.248)
US_Report	−1.576	(−1.417)	−14.514	(−1.047)
Dummy7504	8.129	(9.772)	105.534	(10.012)***
Dummy7509	0.895	(0.936)	18.245	(1.506)
Nicotine-tar	−2.540	(−2.262)**	−30.711	(−2.205)**
Warning1	−1.094	(−0.966)	−13.653	(−0.969)
Workplace	−1.246	(−1.111)	−12.837	(−0.931)
Research	−1.165	(−1.020)	−16.093	(−1.134)
Report1	0.804	(0.717)	1.079	(0.077)
Warning2	−0.015	(−0.013)	−8.288	(−0.600)
Report2	0.528	(0.476)	2.356	(0.172)
Hoarding	81.972	(42.645)***	1103.280	(45.327)***
Stock	−18.246	(−10.405)***	−249.755	(−11.274)***
Time trend	−0.080	(−8.424)***	−0.939	(−8.199)***
ε	−1.126	(−9.886)***	−1.110	(−10.100)***
Adjusted R^2	0.987		0.986	
D–W Statistic	2.459		2.438	
Observations	583		583	

Note: ***significant at 1%; **significant at 5%; *significant at 10%. T-statistics are in parentheses.

About 28.9% of the decrease in cigarette consumption during the April 1975 to October 1999 period can be explained by the increase in real price, about 12.4% by the Workplace ban, about 19.6% by Research, about 17.4% by Report1, about 13.6% by Warning2, and about 8.1% by other factors. Therefore, the total contribution rate of all tobacco control policies during the April 1975 to October 1999 period is about 63.0%, which is bigger than that of tax or price increase.

3.5.2 Nicotine and Tar Intake

I have not direct information on price of nicotine and tar, so I cannot estimate the RA model using nicotine and tar intake. I use the cigarette price as the proxy for the price of nicotine and tar and estimate the intake of nicotine and tar by OLS. The error term is assumed to be AR(1). The results are reported in Table 3.7.

In the column for nicotine intake, the coefficient of P_t is significantly negative and the price elasticity is -1.126. The hoarding is significantly positive, and the stock is significantly negative. The coefficient of $\overline{Nicotine - tar}$ is significantly negative. It implies that the release of nicotine and tar content significantly decreases the intake of nicotine. The other variables are not significant.

In the column for tar intake, the coefficient of P_t is significantly negative and the price elasticity is -1.110. The hoarding is significantly positive, and the stock is significantly negative. The coefficient of *Nicotine-tar* is significantly negative. It implies that the release of nicotine and tar content significantly decreases the intake of tar. The other variables are also not significant.

From Figures 3.1–3.3, it is clear that structural change of nicotine and tar intake took place in the middle of the 1960s,[7] when U.S. report and release of nicotine and tar content were implemented.

These results are consistent with those of cigarette consumption and also are consisitent with those in Wan (2004c).

3.5.3 Robust Results from Survey Data

There are some surveys about smoking and health information in Japan.[8] The samples of the various surveys are assumed to be binomial distributions. Difference tests are used to test whether there are differences about information on the damage from smoking between earlier and later surveys and among smokers, former smokers, and nonsmokers.

Information on the Damage from Smoking Has Increased with Time

There were two surveys that collected information on the damage from smoking.[9] The proportions of those who know about the damage from smoking are summarized in Table 3.8. Here, the values in the "difference" column indicate the increase in the proportion of those who knew about the damage from smoking. All the values are positive and significant; thus, information on smoking damage has increased over time.

Table 3.8 Proportion of those who know about the damages of smoking

All respondents	*Survey 1978 (%)*	*Survey 1999 (%)*	*Difference (%)*	*Test statistic*
Lung cancer	66	84.5	22.5***	17.38
Bronchitis, etc.	45	65.5	20.5***	17.89
Heart disease	16	40.5	24.5***	27.31
Influence on pregnancy	20	79.6	59.6***	64.21
Tobacco dependence	44	51.8	7.8***	6.77
Smokers				
Lung cancer	65	75	10***	5.90
Bronchitis, etc.	45	50	5***	2.77
Heart disease	18	37	19***	12.92
Influence on pregnancy	10	72	62***	51.02
Tobacco dependence	43	55	12***	6.69
Nonsmokers				
Lung cancer	67	89.6	22.6***	16.23
Bronchitis, etc.	46	69.2	23.2***	15.22
Heart disease	15	42.5	27.5***	23.47
Influence on pregnancy	28	85.4	57.4***	42.54
Tobacco dependence	46	50.3	4.3***	2.791

Note: ***significant at 1%; **significant at 5%; *significant at 10%.

Table 3.9 Information difference between smokers and nonsmokers

Survey 1978	*Smoker (%)*	*Nonsmoker (%)*	*Difference (%)*	*Test statistic*
Lung cancer	65	67	2	0.98
Bronchitis, etc.	45	46	1	0.47
Heart disease	18	15	−3**	−1.86
Influence on pregnancy	10	28	18***	11.18
Survey 1999				
Lung cancer	75	89.6	14.6***	18.53
Bronchitis, etc.	58	69.2	11.2***	19.76
Heart disease	37	42.5	5.5***	5.67
Influence on pregnancy	72	85.4	13.4***	16.03

Note: ***significant at 1%; **significant at 5%; *: significant at 10%.

3.5.4 Difference in the Awareness of the Damage from Smoking Between Smokers and Nonsmokers

In Table 3.9, the values in the "difference" column indicate the gap between smokers and nonsmokers in the proportion of those

Table 3.10 Results of Why do you want to quit or reduce smoking?

Smoker	*1981 (%)*	*1988 (%)*	*1999 (%)*	*D1 (%)*	*D2 (%)*
Harmful to health	55.7	78.6	85.5	22.9*** (12.61)	6.9*** (4.30)
Costs a lot	6.2	9	39.2	2.8*** (2.42)	30.2*** (22.98)
People around me do not want me to smoke	6.1	20.3	29.3	14.2*** (9.16)	9*** (5.47)
Advised by family members, etc.	6.2	12.6	14.5	6.4*** (4.88)	1.9 (1.42)
Advised by doctors	4.5		10.5		
Smoking ban in public areas		11.5*** (9.87)	13.1*** (23.81)		1.6 (1.24)
Prohibition at one's workplace			2.4*** (9.62)		

Note: ***significant at 1%; **significant at 5%; *: significant at 10% level. D1: The gap between the figures for the 1981 and 1988 surveys. D2: The gap between the figures for the 1988 and 1999 surveys. Asymptotic *T* statistics are in parentheses.

who knew about the damage from smoking. In the 1978 survey, only two values were significant, but in the 1999 survey, all values were significant and positive. Thus, there was an information gap between smokers and nonsmokers, especially in 1999. One of the interpretations of this result is that nonsmokers did not smoke because they were more aware of the damage from smoking than smokers.

The Reasons for Quitting or Reducing Smoking

Smokers' reasons for quitting or reducing smoking are shown in Table 3.10.[10] The most important reason is "harmful to health" in every year. The change in the importance of the health reason during the 1981–1988 period was bigger than during the 1988–1999 period. This implies that there was a sharp increase in the amount of smoking damage information during the 1981–1988 period.

The second most important reason changed over time. The cost reason was relatively unimportant and increased little in importance during the 1981–1988 period due to the relatively low

real price of cigarettes and to the bubble economy. By contrast, the cost reason increased sharply in importance during 1988–1999 due to the relatively high real price of cigarettes that resulted from the tax increase and to the Japanese depression (in Japanese, Heisei Fukyo).

The results shown in Table 3.10 are consistent with the ones in the econometric analysis in the previous sections.

3.6 Conclusion

Auld and Grootendorst (2004) point that the RA model tends to yield spurious evidence when aggregate data are used; if, however, prices are exogenous, instrumental variable estimates of the coefficients on the lag and lead of consumption will be consistent. Cigarette consumption in Japan is just this case because the cigarette price is not determined by the cigarette firms but totally by the Japanese central government; thus, the price is considered exogenous. The RA model with health information is strongly supported by monthly data for Japanese salaried worker households and several policy events. Information on smoking damage has increased with time. The consumer responds to the increase in health information by changing cigarette type, quitting, or reducing smoking.

The share of filter cigarettes has been increasing since the 1960s due to information disclosure in the United States and Japan. The amount of nicotine and tar per cigarette has decreased continuously since data on nicotine and tar was released in 1967. The intake of nicotine and tar was significantly decreased by the release of nicotine and tar content.

I also get robust evidence from national smoking surveys in Japan. There are information gaps between smokers and nonsmokers. Nonsmokers have more information on smoking damage than smokers. Because health is often the most important one as to why smokers quit or reduce smoking, it is a good idea for tobacco control departments to give smokers more information about health damage.

Tobacco control policies, for example, workplace smoking bans, smoking science research, health warning, nicotine labeling, etc., were shown to be effective in reducing smoking. About 28.9% of the decrease in cigarette consumption during the April 1975 to October 1999 period can be explained by changes in real prices, about 63.0% by tobacco control policies such as workplace smoking ban, health information disclosure. These results are also consistent with the data from one of Japan's national smoking surveys. For tobacco control, therefore, the provision of health information is much more effective than the tax or price increase.

The welfare change arising from increased price and health information is not analyzed in detail in this chapter. It is hoped that these issues will be resolved in the future.

Appendix 3A: Statistical Data

Cigarette purchase by Japanese worker households C_t is cigarette purchase in packs per capita per month. Data are taken from Annual Report of Family Income and Expenditure Survey. Data are purchase data and these were taken into account by using hoarding and stock dummies. Data were seasonally adjusted using X-12 ARIMA.

Nicotine intake $\overline{Nicotine\ intake_t}$ is the monthly intake of nicotine in milligram (mg) per capita. Data are made by multiplying cigarette purchase by nicotine content per cigarette. The nicotine intake from filter cigarette is adjusted by multiplying 50% compared to that from nonfilter cigarette according to "history of tobacco monopoly (Japan Tobacco and Salt Corporation, 1963–1999)." Data were seasonally adjusted using X-12 ARIMA.

Tar intake $\overline{Tar\ intake_t}$ is the monthly intake of tar in mg per capita. Data are made by multiplying cigarette purchase by tar content per cigarette. The tar intake from filter cigarette is adjusted by multiplying 50% compared to that from nonfilter cigarette according to "history of tobacco monopoly (Japan Tobacco and Salt Corporation, 1963–1990)." Data were seasonally adjusted using X-12 ARIMA.

Price P_t is the real average retail cigarette price per pack in each month. It is equal to the Tobacco Price Index divided by the CPI. Data are from the "Annual Report on the Consumer Price Index" and the "Monthly Report on the Retail Price Survey." They were seasonally adjusted using X-12 ARIMA.

Disposable income Y_t is the real per capita salaried worker household disposable income per month. These data are from the "Annual Report of Family Income and Expenditure Survey." It was calculated by dividing average household disposable income by the average number of household members per household and the CPI. Data were seasonally adjusted using X-12 ARIMA.

Tax Rate $\overline{Tax}_t$ is the rate of tax increase. The data are from "Public Finance Statistics."

U.S. Report is a dummy variable relating to the release of "Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service" in 1964 in the United States. It has a value of 0 from January 1951 to December 1963 and a value of 1 from January 1964 to October 1999.

Nicotine and tar is a dummy variable relating to the release of nicotine and tar information. It has a value of 0 from January 1951 to March 1967 and a value of 1 from April 1967 to October 1999.

Warning1 is a dummy variable relating to the warning "Let's be careful about smoking too much for health reasons." It has a value of 0 from January 1951 to July 1971 and a value of 1 from August 1971 to October 1999.

Dummy7504 is a dummy variable for the period April 1975 to July 1975. It has value 1 from April 1975 to July 1975 and a value of 0 for all other periods. The tax increase proposal was passed by the Finance Committee on April 24, 1975, but it was voted down by the Lower House on July 4, 1975.

Dummy7509 is a dummy variable for the period September 1975 to November 1975. It has a value of 1 from September 1975 to November 1975 and a value of 0 for all other periods. The tax increase proposal was submitted to the Diet again on September 20, 1975, and was enforced on December 18, 1975.

Workplace is a dummy variable for smoking bans. It has a value of 0 from January 1951 to March 1978 and a value of 1

from April 1978 when the smoking ban on hospitals, etc., was mandated to October 1999.

Research is a dummy variable for smoking research. It has a value of 0 from January 1951 to March 1986 and a value of 1 from April 1986 when the Smoking Research Foundation was established to October 1999.

Report1 is a dummy variable for the first edition of "Report on Smoking and Health." It has a value of 0 from January 1951 to September 1987 and a value of 1 from October 1987 when the report was released to October 1999.

Warning2 is a dummy variable relating to the warning "Let's be careful about smoking too much because there is a possibility it will ruin your health." on the cigarette label. It has a value of 0 from January 1951 to December 1989 and a value of 1 from January 1990 when the warning was mandated to October 1999.

Report2 is a dummy variable for the second edition of 'Report on Smoking and Health.' It has a value of 0 from January 1951 to May 1993 and a value of 1 from June 1993 when the report was released to October 1999.

Hoarding is a dummy variable for months just before cigarette tax increases. According to Wan (2004a) the lead of $\overline{Tax_t}$ is a valid proxy for $\overline{Hoarding}$.

Stock is a dummy variable for months immediately after cigarette tax increases. According to Wan (2004a), $\overline{Tax_t}$ is a valid proxy for $\overline{Stock}$.

Appendix 3B: Surveys

1978 Survey on Smoking

An opinion poll on smoking was conducted by the Mainichi Shimbun Corporation in April 1978. A total of 2,176 pollees were randomly chosen from among persons aged 20 and over in Japan, and they were interviewed by the polltakers. The response rate was 73%. The smoking rate of adult males was 75% and that of adult females was 13%. These results are broadly consistent with the results of the Japan Tobacco and Salt Public Corporation (JT) survey in which the male rate was 74.7% and the female rate was

16.2%. Respondents were asked the following question: What do you regard as the harmful effects of smoking? There were 12 items from which to choose and more than one could be chosen.

1981 National Survey on Smoking

This survey (in Japanese, Kitsuen ni Kansuru Zenkoku Ishiki Chosa) was conducted by Tadao Shimao who was the chief researcher in the Research Institute of Tuberculosis Japan Anti-Tuberculosis Association in 1981. A total of 5,394 adult persons, who were the families or friends of members of the 47 branches of the Japan Anti-Tuberculosis Association in all prefectures, were surveyed. The survey period was from February 1981 to March 1981. A self-registering paper questionnaire method was used. There were 2,933 male respondents (54.4% of the total) and 2,461 female respondents (45.6% of the total). The male and female share in the total population were 49.2% and 50.8%, respectively, in October 1980.

1988 Survey on Smoking and Health

This survey (in Japanese, Kitsuen to Kenkou ni Kansuru Yoron Chosa) was conducted by the Public Relations Office of the Prime Minister's Office of Japan during the October 27 to November 6, 1988, period. A total of 2,339 persons aged 20 and over were surveyed. They were selected from throughout Japan using a two-stage stratified random sampling method. The response rate was 78.0%. The survey method used was direct interviewing of respondents.

1999 National Survey on Smoking and Health

This survey was conducted by the Ministry of Health and Welfare of Japan during the February 17 to March 2, 1999, period. A total of 12,858 persons aged 15 and over were surveyed. They were randomly selected from the sample used for the 1998 "Basic Survey on National Life" in fiscal year 1998 (the period April 1, 1998

to March 31, 1999). The response rate was 91.9%. The survey method was direct interviewing of respondents. The smoking rate of adult males was 52.8% and that of adult females was 13.4%. These results are very close to those of the JT survey in which the male rate was 55.2% and the female rate was 13.3%. Respondents were asked the following question: What do you regard as the harmful effects of smoking? There were eight answers from which to choose and more than one could be chosen.

4

Responses of Consumers to Mandatory Disclosure of Information: Evidence from Japanese Interbrand Cigarette Sales

4.1 Introduction

Whether there is a need for mandatory disclosure of information continues to be hotly disputed. Many economists insist, by means of theoretical analyses, that mandatory disclosure is necessary, and much empirical evidence supports this view. However, some economists do not accept this claim and strong evidence has recently been provided that undermines the idea that more information is better.[1] Thus, clarification of which side of the debate provides the most accurate description of reality is still needed and has important implications for policy making and legislation. This study provides new evidence that mandatory disclosure decreases tar intake, increases consumer welfare, and makes monopolistic firms improve product quality. A new empirical technique for testing the effect of mandatory information disclosure, which makes use of a difference-in-difference (DID) approach, is also provided for directly estimating those changes in interbrand cigarette demands resulting from policy changes and increased information awareness about nicotine and tar content levels.

Another aim of this research was the provision of relevant evidence in support of the recent legislation and legal changes regarding information disclosure in Japan. Scholars, consumers,

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

and policymakers have begun to voice concerns regarding issues related to information disclosure. For example, the disclosure of information regarding genetically recombinant food has recently become a hot topic both globally and in Japan. As a result, the Democratic Party submitted the "Food Safety Proposal" to the Parliament on March 29, 2002. Article Five of this law specifies "an entrepreneur's duty" as comprising the obligation of economic agents to display warning or caution labels on food products, to perform quality checks during production, and to provide appropriate product information and warnings; this "duty" includes the country's or the local organizations' obligation to support producers in the process of safe product storage. Though the "Food Safety Proposal" is currently being discussed, the key question here is whether this proposal is really warranted; that is, whether consumers have enough information already about food without the need for additional labeling.

In addition, proper labeling concerning the quality of agricultural and forestry products is specified in the JAS Law (the law related to the standardization and suitability of product quality information for agricultural and forestry materials). Standards for consumer information, as well as penalties in the event of their violation, have been amended recently. Furthermore, new standards concerning fresh or perishable food have been enforced since July 1, 2000, and new standards for processed and genetically recombinant food took effect on April 1, 2001. In addition, some penalties for violations of consumer information standards have been increased. Under the new law, an individual perpetrator faces up to 1 year in prison or up to 1 million yen in fines (previously the penalties involved no imprisonment and up to 0.5 million in fines). In the case of an organization, the maximum penalty is now a 100 million yen, as compared with a mere 0.5 million previously. Further legal regulations include the Food Sanitation Law and the Product Liability Law.

Whether the product information provisions regulated by such laws have any effect is related to three issues. The first relates to the extent to which sellers disclose information about their products, the second is the question of how consumers react to newly released information, and the third is the issue of whether

sellers improve the quality of their products in response to the mandatory disclosure of information. It is crucial, therefore, to test these issues empirically.[2] However, it is very difficult to measure the effect of information disclosure, for two main reasons. First, the abstract and broad character of information make it difficult to quantify and define. Second, it is hard to separate the effects of information disclosure from the effects of other factors. For example, even if some information is presented and has an effect, the economy always changes, and thus any effect is mixed with those of other factors in creating the final effect. As a result of these problems, research on information disclosure is rare, in general, and has been virtually nonexistent in Japan.

This chapter proposes a new method for verifying the effects of information disclosure. Using cross-sectional time-series data, I investigated consumers' responses to public information announcements. Since they responded to the newly disclosed information, this implies that they originally had insufficient information. However, an absence of a statistically significant consumer response could have meant that the amount of information previously available was sufficient or that the disclosure of information had no effect, or both. I also analyzed the behavior of a monopolistic firm during the periods of voluntary disclosure and mandatory disclosure.

Clarification of the ways in which information disclosure has influenced changes in the demand for cigarettes of various brands is important for several reasons. It is widely known that cigarettes are an addictive good and that it is difficult to give them up. The drug heroin is said to be the most addictive good; it is closely followed, however, by cigarettes and alcohol. The degree of addiction induced by general goods, such as instant juice or vegetables, is considered to be low or close to zero. Furthermore, it is commonly believed that consumers' responses with regard to addictive goods are less sensitive to exogenous information shock than is the case with general goods, as the consumer cannot easily give up addictive goods or find substitutes. Therefore, in the event of a statistically significant effect of information disclosure on the consumption of the addictive good tobacco, we might conjecture that there is a similar, but stronger, effect on the

consumption of general goods. In this study, I present the results of a "natural experiment," comprised of an empirical test that distinguished information disclosure effects from other effects. Specifically, I estimated the effect of information disclosure by examining several different consumer groups, that is, treatment groups with various levels of consumer information disclosure impact, and control groups that received little or no information. Moreover, I performed difference tests to demonstrate the impact of mandatory disclosure on a monopolistic firm.

The composition of this chapter is as follows: Section 4.2 reviews previous research. Section 4.3 introduces the present state of information disclosure in Japan. Section 4.4 describes events regarding smoking in Japan. Section 4.5 presents the data and a detailed description of the problems encountered and explains the empirical strategies and solution techniques used. Section 4.6 shows the model and estimation techniques. Section 4.7 reports the estimation results. Finally, Section 4.8 concludes and discusses issues relevant to future research.

4.2 Previous Research

4.2.1 Theoretical Research

Very few theoretical research articles have been written on the topic of information disclosure. The most influential works have been Grossman (1981) and Milgrom (1981). Grossman (1981) analyzed a seller's behavior with regard to information disclosure. In his model, a buyer does not know the quality of goods on the market, while a monopolistic seller knows both the quality of his goods and the buyer's preferences. The seller decides on a strategy with regard to how much information to disclose. Furthermore, it is assumed that the cost to the seller of information disclosure is zero and that the buyer can confirm whether the disclosed information is true or false without cost after purchasing the good (e.g., the consumer might wish to verify the advertised weight of a diamond). It is also supposed that, although the buyer believes in the validity of any disclosed information, he or she may have some doubts concerning any remaining undisclosed

information, possibly because of the good's poor quality. In this setting, the optimal strategy of the seller is to completely disclose all information. Furthermore, one can also consider the seller's costs of information disclosure and customer persuasion (the seller's explanation and persuasion costs), and the cost to the buyer of confirming the information after purchase (e.g., it takes time for the buyer of a used car to evaluate the real status of the car). Within such a framework, and with no moral hazard (e.g., the buyer does not deliberately destroy the car), the optimal strategy of the seller is to completely disclose all information and to provide the buyer with complete quality assurance. Mandatory disclosure is thus not needed because it is in the interests of the firm to disclose all information voluntarily.

Verrecchia (1983) introduced a nonzero information disclosure cost into the standard model. In his article, a seller does not choose the formerly unique solution of full disclosure when there are costs associated with this disclosure (e.g., the cost of information dissemination or the benefits of such information to a hostile enterprise). The seller instead chooses to disclose information only when the profits from such a decision exceed the costs. More recently, several articles have researched information disclosure. For example, Fishman and Hagerty (2003) have pointed out that in certain situations, mandatory disclosure might be worse than voluntary disclosure. However, Akita and Maeda (2005) analyze the effect of bank disclosure on the efficiency of resource allocations and find that mandatory disclosure improves social efficiency when bankruptcy costs of banks are considered. In short, there is still no consensus in the theoretical literature as to whether mandatory or voluntary disclosure is better.

4.2.2 Empirical Research

Some empirical work has suggested that information disclosure influences consumption in the United States. One article analyzed the effect on egg and food oil consumption patterns of information with regard to the negative impact of cholesterol on health. Brown and Schrader (1990) demonstrated that health information influenced the consumption of eggs. The accumulated yearly

number of articles espousing either of two opposing viewpoints (that cholesterol is either good or bad for the health) published in medical magazines between 1955 and 1987 was indexed as a measure of information. Time series for the period from 1955 to 1987 were used to show that the dissemination of information suggesting that cholesterol was bad for the health brought about a significant reduction in egg consumption. Furthermore, the introduction of health information empirically helped to explain the phenomenon that egg consumption in America decreased, despite a decline in the price of eggs.

Yen and Chern (1992) investigated the consumption of seven kinds of animal and vegetable oils using time-series data for the period 1950 to 1980 and the cholesterol index of Brown and Schrader (1992) as a proxy variable for health information. Their empirical result was that the consumption of animal oil was reduced and that vegetable oil consumption significantly increased as a result of the disclosure that cholesterol is bad for health. Chern et al. (1995) verified the effect of health information on consumption by using data similar to that of Yen and Chern (1992). The averages and variances of consumers' beliefs were used as proxy variables for information measures, in accordance with the Bayesian information model. They used data on the percentage of people who believed that cholesterol is bad for health, derived from a survey carried out by the American Food and Medical Administration Office, as well as the cholesterol index of Brown and Schrader (1992). Their results were consistent with those of Yen and Chern (1992).

Ippolito and Mathios (1995) also provided evidence that the dissemination of information on the negative effects of cholesterol had an impact on food consumption. In the context of their study, producers' food packaging and advertisements were either free or costly, though the causalities between oil (cholesterol) and sickness had been presented to the general public between 1977 and 1985, with the government as the general source of information. Regulation of producers' food packaging and advertising was enacted between 1985 and 1990. The authors verified that these regulations had had an impact on consumption by examining the survey data (1977, 1985, 1986, 1987, 1988, 1989, and 1990)

for 48 states, provided by the American Agricultural Ministry. The consumption of low-fat foods, such as cereals, increased significantly, while the consumption of high-fat foods, such as meat and eggs, decreased significantly.

Furthermore, Mathios (2000) examined nutrition label information and supermarket scanner data before and after the introduction of the Nutrition Labeling and Education Act and found that mandatory labeling had had an impact on consumers' behavior and health. However, Dranove et al. (2003) provided evidence that public disclosure of patient outcomes had decreased patient and social welfare. Jin and Leslie (2003) presented a new approach for analyzing the effect of an increase in the product quality information provided to consumers on a firm's decisions regarding product quality. They used restaurant hygiene grade cards as the measure of information disclosure and provided evidence that these grade cards caused restaurants to make hygienic quality improvements, although they could not directly estimate the demand for restaurant food due to the lack of each restaurant's price information.

This article differs from that of Jin and Leslie (2003) in three main respects. First, the estimation approach adopted directly estimated demand by means of disclosed information rather than by means of estimated revenue. Second, it focuses on the behavior of a monopolistic firm in response to mandatory information disclosure, whereas Jin and Leslie (2003) focused on relatively competitive firms (restaurants) under both mandatory and voluntary disclosure. Third, this article focuses on an addictive good (cigarettes), whereas this was not the case in Jin and Leslie (2003).

Viscusi (1992) analyzed the disclosure effect of information that smoking is harmful to the health on smoking behavior, using American survey data. He found that the probability that an informed person would smoke was lower than that for an uninformed one. Furthermore, the introduction of such information significantly decreased cigarette consumption. Yorozu and Zhou (2002) and Wan (2002c) analyzed the effect of information dissemination on cigarette consumption in Japan.

Yorozu and Zhou (2002) used prefectural sales data and a prefectural dummy based on whether there was a smoking and health advertising budget as measures of information dissemination in order to verify the effect of increased information on cigarette consumption. Consumption in the prefectures that had a budget for advertising decreased significantly. Along similar lines, Wan (2002c) used monthly data and event dummies to analyze the effect of information on total consumption and concluded that information regarding the damage potentially caused by smoking reduced consumption significantly.

In previous research, advertisements, regulations, and opinion polls were used as measures of information. By contrast, I used not only policy information, such as regulation, but also the contents of goods, as measures of information in my analysis. The measures of information discussed in this chapter are reliable, and the measurement bias of this information is low. Furthermore, the estimation approach used in this chapter differs significantly from those used in previous research in that I used interbrand demand directly by means of a DID approach. Although much research related to cigarette consumption has been conducted using both macro- and microdata, there has been no analysis conducted, to date, of the way in which nicotine and tar content information disclosure has impacted inter-brand cigarette demand by causing consumers to switch products. This inquiry is thus the first of its kind.

4.3 Present State of Information Disclosure in Japan and the Theory of Information Disclosure

It is a matter of established fact that not only in the past but also in the present the JT and other Japanese food makers have been unwilling to disclose full information about the quality of their products. This can be explained by means of the information disclosure theory.

In the case of Japanese cigarette consumption, it is very costly for a consumer not to obtain information about cigarette quality (such ignorance might cost one one's life). In addition, as insisted

in Grossman (1981) it is possible that, in the presence of moral hazard, the options of full information disclosure and offering a complete guarantee for the goods are not chosen. This may be why JT, a monopolistic supplier, does not voluntarily choose to disclose full information or to provide complete guarantees for its products (e.g., by offering compensation if the consumption of its product has a harmful impact on the health of consumers). Consistent with the results of the Verrechia (1983) model, JT has not disclosed information whenever such information has been unfavorable. Thus, one may take the position that the Ministry of Finance should coerce the JT to disclose information regarding its cigarettes in order to improve the welfare of cigarette consumers.

The fact that this Japanese food maker does not want to disclose full information voluntarily can be explained by the costs of information disclosure that arise for both the seller and the buyer. For example, although genetically recombinant food differs little from ordinary food in its taste, it is thought that it might be more dangerous than common food. At this time, due to technical limitations and costs, it is impossible for a consumer to check whether a particular food item is genetically recombinant. Moreover, if there is no government regulation in this area, the seller must incur an enormous cost to prove to the buyer that the food he or she sells is not genetically recombinant.

Therefore, because of the enormous costs of information disclosure and verification, the government must legislate information disclosure and establish organizations for information verification (e.g., various governmental inspection sections). In addition, a substantial tax should be charged to cover costs; information disclosure on the part of sellers should be enforced and the government, in accordance with appropriate laws, should examine the information disclosed by sellers for validity.

4.4 Policy Events Regarding Smoking in Japan

Three policy events pertinent to smoking in Japan were used to measure information quantitatively. The first occurred on February 6, 1964, when the Ministry of Health and Welfare of Japan sent

for dissemination "A Notice about Health Damage from Smoking" to prefectural governors and to the mayors of several designated cities, as a result of the influence of the U.S. "Smoking and Health Report," published in 1964 (Minstry of Health, Welfare of Japan, 1987, 1993, and Japan Tobacco Salt Monopoly, 1963–1990). We may consider this to be a kind of completely exogenous shock to the consumer, as the government, for the first time, officially informed consumers about the negative health effects of smoking.

The second information disclosure event in Japan was concerned with the nicotine and tar content of cigarettes. In 1967, the amounts of nicotine and tar per cigarette were published in the newspapers, on the instructions of the Ministry of Finance. We can also consider this event as constituting a completely exogenous information shock for the following reason. Before this disclosure, neither consumers nor JT possessed information about nicotine and tar levels; nicotine and tar levels were first measured in 1967. Before 1967, both demand and supply sides had no information concerning nicotine and tar levels. As information regarding the levels of nicotine and tar had not yet been disclosed, even as late as 1966, it can be assumed that consumers' knowledge of nicotine and tar levels did not affect their consumption of cigarettes. After 1967, however, it can be inferred that consumers' behavior was influenced by the new information.

The third information disclosure event occurred on April 20, 1972, when the Japanese Ministry of Finance issued a direction to companies to put a warning label on cigarette packs. Specifically, manufacturers were required to add the label, "Let's be careful about smoking too much for health reasons." This warning had to be displayed on the packs of all brands from April 1972.

4.5 Data, Data Issues, and Their Solutions

4.5.1 Data and Graphs

The time-series sales data for each brand come from the "National Budget" and the "history of tobacco monopoly (Japan Tobacco and Salt Corporation, 1963–1990)." Fifty-five brands that

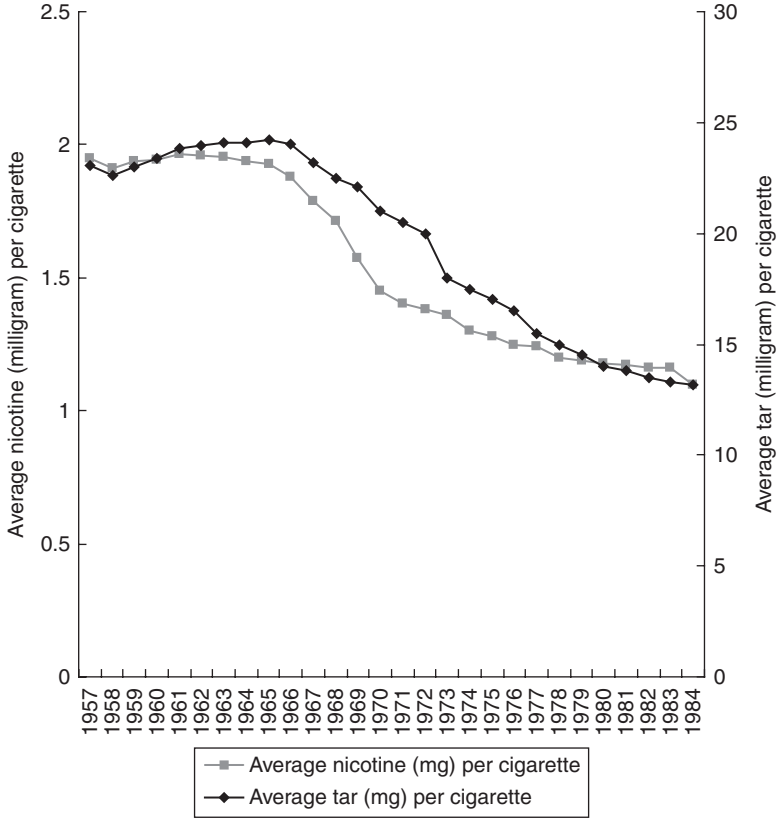


Figure 4.1 Average nicotine and tar content per cigarette.

comprised more than 95% of the total market share (after 1960) were used. In addition, data included each brand's price and respective levels of nicotine and tar. The nicotine and tar-level data were announced officially in the Asahi Shimbun and the Mainichi Shimbun.[3]

Policy dummies were used to indicate whether disclosure of information had occurred, that is, they were taken as "0" before an event occurred and "1" after the event. A time trend was also used. In addition, macroeconomic factors, such as income and population, were taken into consideration. The time transition of nicotine and tar levels per cigarette is presented in Figure 4.1. This graph shows that cigarettes' nicotine and tar contents

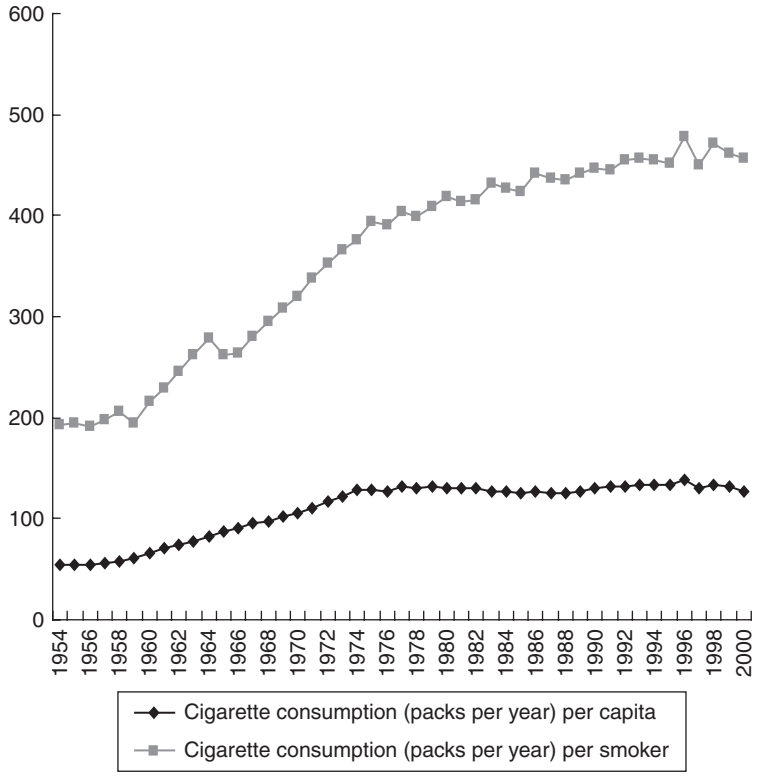


Figure 4.2 Cigarette consumption per capita and per smoker.

decreased after 1967, and that the decrease in nicotine levels was slightly more sudden than that of tar. Figure 4.2 presents the time transition of annual per capita cigarette consumption versus annual consumption per smoker. Cigarette consumption per capita increased until the mid-1970s and then leveled off. Cigarette consumption per smoker has been increasing until the present time.[4] The total intake of nicotine and tar per capita is presented in Figure 4.3. Nicotine consumption exhibited an upward trend until 1967 but declined thereafter. This trend then reversed upward again until 1972, but shifted to another downtrend thereafter. Tar consumption, on the other hand, increased slowly after 1967 and declined from 1972. The total intake of nicotine and tar per smoker is presented in Figure 4.4. The pattern of nicotine consumption exhibits similar tendencies to

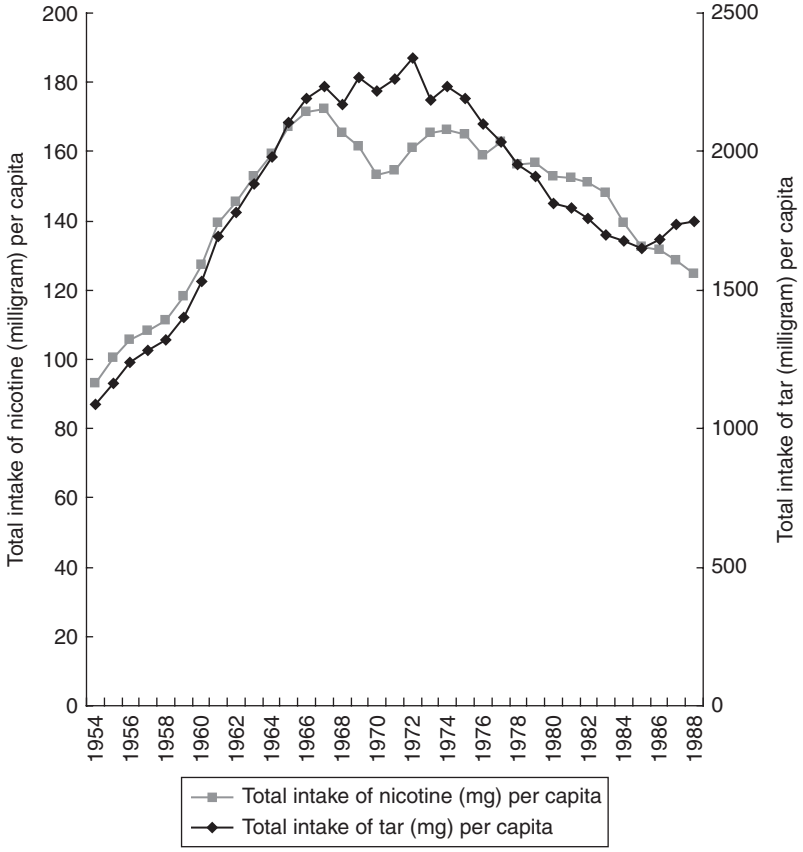


Figure 4.3 Total intake of nicotine and tar per capita.

that of tar; the trend was upward until 1963, but then shifted to a downtrend from 1964. However, it is noteworthy that in 1972, nicotine consumption moved in the opposite direction to that of tar consumption.

To help assess the subjective changes in consumer consciousness that occurred with the dissemination of new information, this analysis made use of the number of newspaper articles with headlines containing relevant keywords. As shown in Figure 4.5, the number of articles with titles related to the harmful effects of smoking, or to not smoking, suddenly increased after 1964. There were a few more articles with titles including the keyword

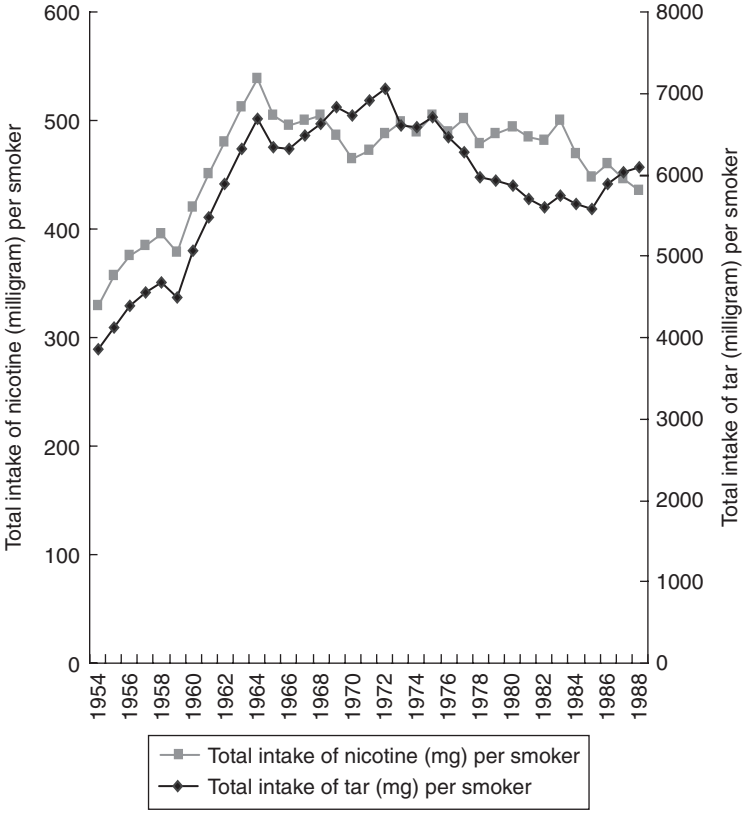


Figure 4.4 Total intake of nicotine and tar per smoker.

"nicotine" than there were titles including "tar" around 1967, although the number of articles with titles containing the key word "tar" increased from 1972. It seems that these changes in consumer consciousness correspond to the changes in consumption patterns shown in Figure 4.1 and to the changes in the total intake of nicotine and tar shown in Figure 4.4.

4.5.2 Data Issues

Data After 1984 Omitted

New brands are introduced to the market successively. This could result in underestimation of the effect of information disclosure, as newer brands tend to have lower levels of nicotine and tar; thus,

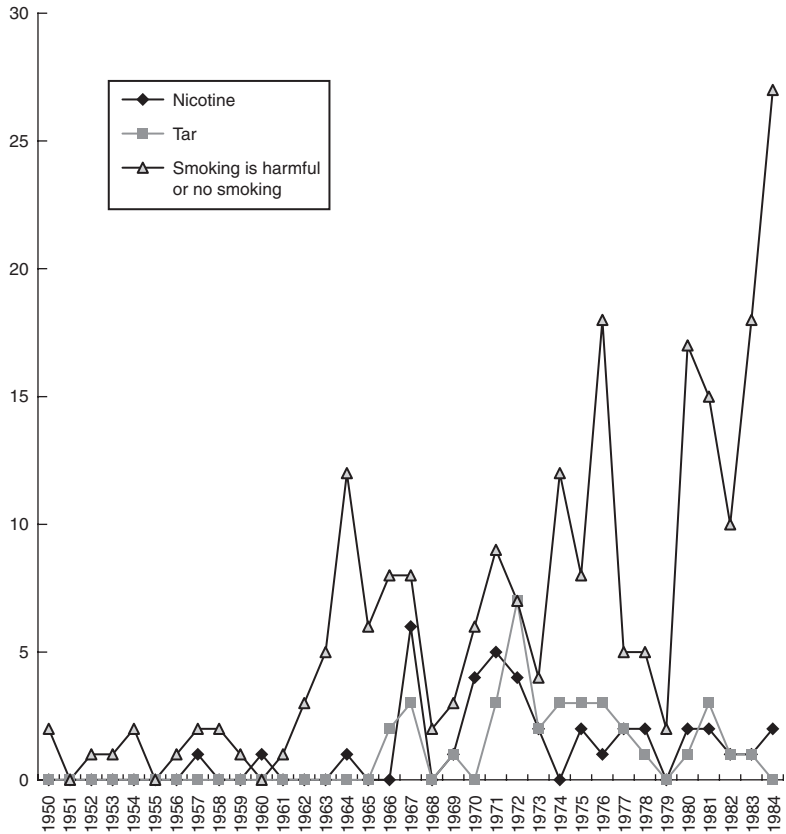


Figure 4.5 Number of articles in the Asahi Shimbun with headlines including certain keywords.

data for brands introduced after 1984 were not included in the econometric model.[5] However, the effect of information disclosure was significant, even with this omission, which implies that the effect of information disclosure would have been much greater if the data for newer brands had been included in the estimated model.

Missing Values

An assumption that the sales of new brands were zero in the period prior to their release, 1950–1984, would have been too strong.

In other words, JT was assumed to be capable of supplying any brand at any time and the possibility that a new brand could not be sold at all times was not considered. This corresponds completely with consumer demand for brands before they were introduced, an assumption that is clearly not realistic. Moreover, because price information was lacking, data for new brands for the period prior to their availability were, of necessity, dropped and were considered to be missing values in this analysis. Additionally, a similar problem arose in dealing with the sales volume of a particular brand in the period after its sale had been stopped due to a lack of market demand. The question arose as to whether to use zero or to assume a missing value; thus, it is necessary to discuss the potential biases of the estimators resulting in each case.

4.5.3 Data Problem Solutions

The first step was to construct two samples, a full sample and a subsample. In the full sample, the volume of sales during the period after a brand had been discontinued was chosen as zero, and the price, nicotine, and tar levels of the brand just before sales ceased were used as data for the brand for the period after its discontinuation. In the subsample, values for the postbrand period were dropped (688 remained after 150 had been dropped).

The second step was to estimate the econometric model using the full sample. The estimates from the full sample regression may have overestimated the effect of information disclosure because the sales of discontinued brands may not have been identically zero, that is, some would have continued to be sold in small amounts, if not completely withdrawn from the market. Thus, zero consumption of these brands constitutes an extreme case.

The third step was to estimate the model using the subsample. The estimation in this case was likely to underestimate the coefficients because the omitted values tended to be overrepresented by the data for the period when a brand was on sale and because the sales of a discontinued brand might, in fact, have been zero, even if it were not withdrawn from the market. Finally, I compared these two types of estimates. The true value of the parameter should fall between the two estimates resulting from the previously detailed regressions.

4.6 Model and Estimation

4.6.1 Impact on Consumers

Modeling the Effect of the 1964 Policy Event

The response of consumers to the 1964 policy event can be considered as represented by the adjustment of total cigarette consumption and interbrand switching. Ideally, a consumer should restrict her consumption of plain cigarettes, if she only has information regarding plain and filter cigarettes. Therefore, plain cigarette consumption was used to characterize a treatment group and filter cigarette consumption was used to characterize a control group.

Modeling the Effect of the 1967 Policy Event

In 1967, the response of consumers to the disclosure of information about nicotine and tar content levels can be thought of as being represented by switches among brands or adjustment of total consumption, following the disclosure of nicotine and tar information. Once consumers became aware that nicotine and tar were bad for their health, demand for the brand with a high nicotine or tar content would have decreased, while demand for low-nicotine brands characterizing the control group would have increased.

Modeling the Effect of the 1972 Policy Event

Consumer response to the warning label on cigarette packs, "Let's be careful about smoking too much for health reasons," introduced in 1972, can also be thought of as the market's response to the disclosure of nicotine and tar information in 1967.

Econometric Model

As in the model of Wan (2002c), consumers' consumption of cigarettes was based not only on cigarette price, but also on available information concerning the damaging effects of smoking. If one ignores the aspect of addiction, a simple model for cigarette brand demand can be described as follows: demand for brand$_{it}$

$= f$ (the attributes of the brand$_{it}$; policy information; etc.). The attributes of the brand, and policy information, can be used as a proxy for the extent of consumer information about the harmful effects of smoking.

$$\begin{aligned} D_{it} = {} & \beta_0 + \beta_1 * \overline{time} + \beta_2 * \overline{realprice}_{it} + \beta_3 * \overline{realincome}_t \\ & + \beta_4 * \overline{after}64 + \beta_5 * \overline{plain}_i + \beta_6 * after64 * \overline{plain}_i + \beta_7 \\ & * \overline{after}67 + \beta_8 * \overline{tar}_{it} + \beta_9 * \overline{after}67 * \overline{tar}_{it} + \beta_{10} * \overline{nicotine}_{it} \\ & + \beta_{11} * \overline{after}67 * \overline{nicotine}_{it} + \beta_{12} * \overline{after}72 + \beta_{13} * \overline{after}72 * \overline{tar}_{it} \\ & + \beta_{14} * \overline{after}72 * \overline{nicotine}_{it} + a_i + u_{it}. \end{aligned}$$

There are three assumptions:

$$\overline{Assumption}\ 4.1: \ E(u_{it}|x_{itj}, a_i) = 0,$$

$$\overline{Assumption}\ 4.2: \ \overline{Cov}(x_{itj}, a_i) = 0,$$

$$\overline{Assumption}\ 4.3: \ \overline{Corr}(v_{it}, v_{is}) = \sigma_a^2/(\sigma_a^2 + \sigma_u^2),$$

where $t \neq s$, $v_{it} = a_i + u_{it}$, $\sigma_a^2 = \overline{Var}(a_i)$, $\sigma_u^2 = \overline{Var}(u_{it})$, and x are explanatory variables, and $j = 1, 2, \ldots$, is the number of explanatory variables; $i = 1, 2, \ldots, 55$; $t = 1, 2, \ldots, 35$.

The three assumptions presented above are consistent with the characteristics of the sample. It can be easily verified that Assumptions 4.1 and 4.2 are satisfied by the sample used, as the explanatory variables were the attributes of brands and policy information. Furthermore, the likelihood that the error terms were serially correlated was high, as the dataset was a 55-brand time series spanning 35 years. This is consistent with the third assumption. The following hypotheses were constructed. For the event in 1964, it was expected that $\beta_6 < 0$. For the next event, it was expected that $\beta_9 < 0$ and $\beta_{11} < 0$. For the event in 1972, it was expected that $\beta_{13} < 0$ and $\beta_{14} < 0$. A time trend was included in the estimated model to control for the possibility that consumers' preferences might have changed with time. The number of observations, maximum value, minimum value, average, standard error, and so on, for each variable, are given in Tables 4.1 and 4.2. The variables were constructed as follows:

Table 4.1 Descriptive statistics for the full sample

Variable	*Observation*	*Mean*	*Std. dev.*	*Min.*	*Max.*
id	838	21.19	14.29	1.00	55.00
year	838	1974.70	7.62	1950.00	1984.00
real price	838	0.09	0.04	0.02	0.28
demand_per	838	74.35	164.08	0.00	1114.09
real income	838	12.26	3.45	2.10	15.37
demand	838	7890.35	17783.73	0.00	132234.20
on_sale	838	1.00	0.00	1.00	1.00
nicotine	838	1.43	0.49	0.30	2.76
tar	838	19.91	4.97	6.00	32.00
nominal_price	838	6.46	3.12	1.50	14.43
disposable_income	838	115397.80	66875.60	2820.41	207215.00
population	838	110555.10	8863.77	83200.00	120235.00
cpi	838	73.90	30.60	16.14	112.10
after64	838	0.90	0.30	0.00	1.00
after67	838	0.85	0.35	0.00	1.00
after72	838	0.72	0.45	0.00	1.00
plain	838	0.26	0.44	0.00	1.00
after64*plain	838	0.18	0.38	0.00	1.00
after67*nicotine	838	1.14	0.63	0.00	2.76
after67*tar	838	16.10	7.85	0.00	32.00
after72*nicotine	838	0.93	0.68	0.00	2.70
after72*tar	838	13.20	8.91	0.00	32.00
time	838	25.70	7.62	1.00	35.00
articles	838	9.95	7.13	0.00	27.00
nicotine*articles	838	13.19	9.97	0.00	72.90
tar*articles	838	186.57	133.60	0.00	864.00

D: annual demand for each brand, divided by the Japanese population;
time: a time trend, 1950, 1951,⋯, 1984;
real price: the nominal price of each brand, which was totally controlled;
by the Japanese government, divided by the CPI;
real income: Japanese per capita disposable income;
after64: time dummy: 1 after 1964 and 0 before 1964;
plain: dummy for plain brands: 1 if the brand was plain and 0 if the brand was filter-tipped;
after64*plain: term for the intersection of after64 and plain;

Table 4.2 Descriptive statistics for the sub-sample

Variable	*Observation*	*Mean*	*Std. dev.*	*Min.*	*Max.*
id	688	21.84	14.08	1.00	55.00
year	688	1973.59	7.84	1950.00	1984.00
real price	688	0.09	0.04	0.02	0.28
demand_per	688	90.56	177.00	5948.00	1114.09
real income	688	11.79	3.63	2.10	15.37
demand	688	9610.63	19203.04	0.06	132234.20
on_sale	688	1.00	0.00	1.00	1.00
nicotine	688	1.41	0.48	0.30	2.76
tar	688	19.68	4.98	6.00	32.00
nominal_price	688	6.14	3.06	1.50	13.32
disposable_income	688	104854.70	67176.35	2820.41	207215.00
population	688	109251.00	9153.82	83200.00	120235.00
cpi	688	69.10	30.87	16.14	112.10
after64	688	0.88	0.32	0.00	1.00
after67	688	0.82	0.38	0.00	1.00
after72	688	0.67	0.47	0.00	1.00
plain	688	0.26	0.44	0.00	1.00
after64*plain	688	0.16	0.36	0.00	1.00
after67*nicotine	688	1.05	0.62	0.00	2.76
after67*tar	688	15.04	8.00	0.00	32.00
after72*nicotine	688	0.79	0.63	0.00	2.20
after72*tar	688	11.57	8.70	0.00	27.00
time	688	24.59	7.84	1.00	35.00

after67: time dummy: 1 after 1967 and 0 before 1967;
tar: the tar content of each brand as disclosed in the newspapers;
after67*tar: term for the intersection of after67 and tar;
nicotine: the nicotine content of each brand as disclosed in the newspapers;
after67*nicotine: term for the intersection of after67 and nicotine;
after72: time dummy: 1 after 1972 and 0 before 1972;
after72*tar: term for the intersection of after72 and tar;
after72*nicotine: term for the intersection of after72 and nicotine.

Multicolinearity

As high-tar brands always have a high nicotine content, tar content is strongly and positively correlated with nicotine content, as is

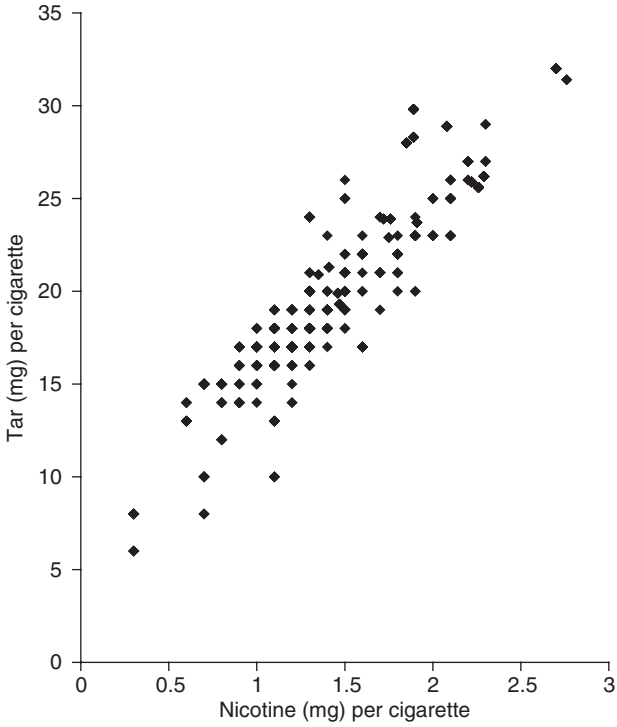


Figure 4.6 Nicotine content versus tar content of each brand.

shown in Figure 4.6. The possibility of multicolinearity arises when nicotine and tar are both included in a regression equation, and thus either nicotine or tar was dropped from the model to control for this potential problem.

Nicotine and Tar Measurement Errors Reported by JT

JT tends to underreport the amounts of nicotine and tar in its cigarettes each year because this strategy is considered likely to increase the demand for cigarettes. In this type of situation, attenuation bias will become more serious when fixed-effect estimation is used. Thus, random-effect panel estimation was used here to control for the bias caused by the measurement errors induced by misreporting.

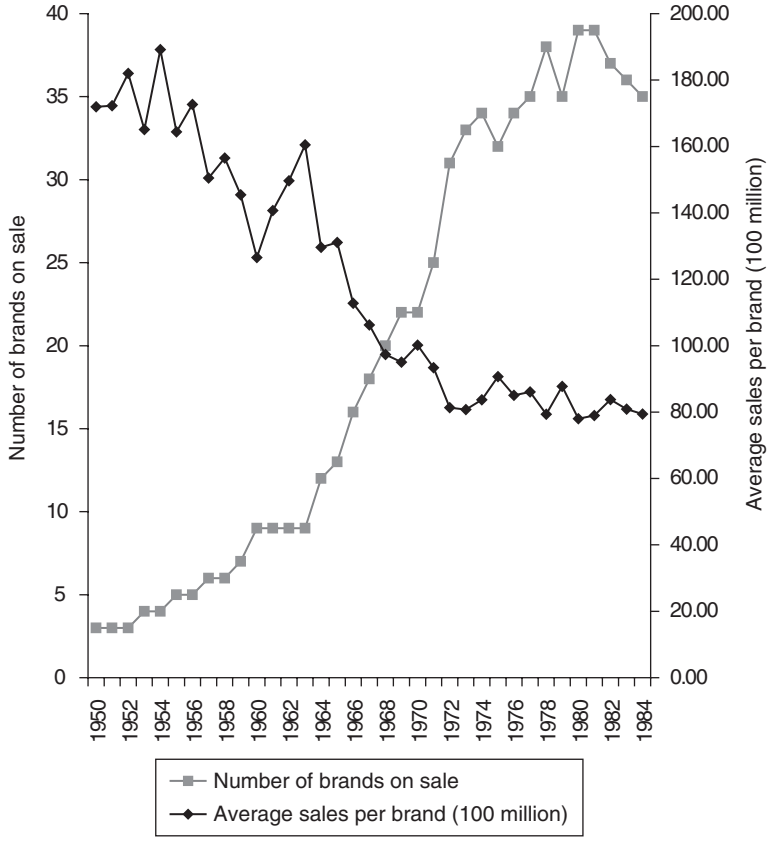


Figure 4.7 Number of brands on sale and average sales per brand.

Random-Effect GLS Panel Estimation

Random-effect GLS panel estimation was used in this analysis because it facilitated correction for the serial correlation of error terms and the reported nicotine and tar measurement errors under Assumptions 4.1–4.3. A further important reason for using this method was that nicotine and tar content levels are nearly time-invariant.

4.6.2 Impact on the Monopolistic Firm

Figures and difference tests were used to determine the impact of mandatory disclosure on the monopolistic firm. Figures 4.7–4.12

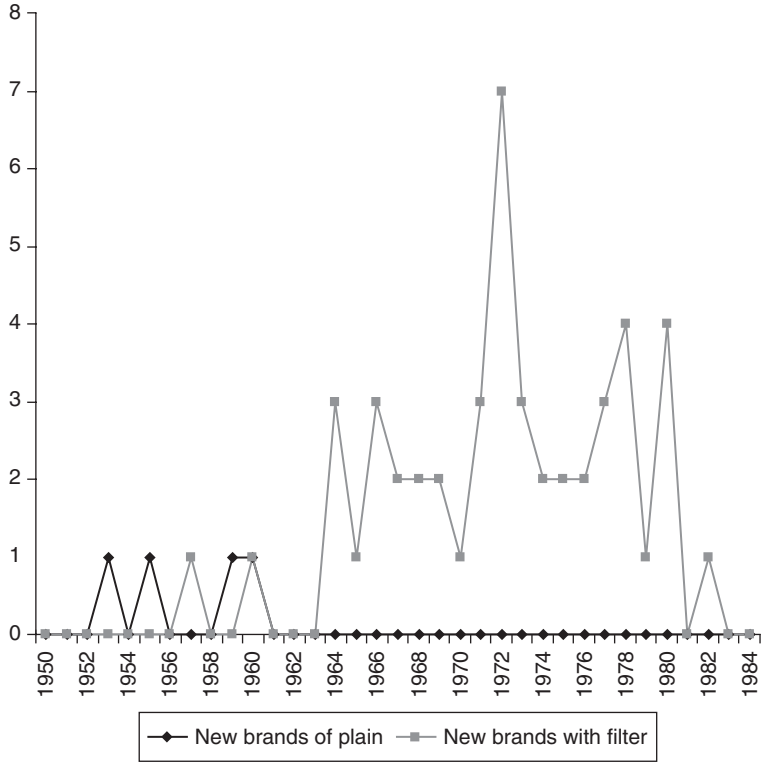


Figure 4.8 Number of new plain brands versus number of new filter-tipped brands.

show JT's behavior both before and after the mandatory disclosure regulation was imposed. Difference tests for the nicotine and tar content of discontinued brands, as well as those of new brands, both before and after 1967, were performed to verify whether there were significant differences.

4.7 Results

4.7.1 Impact on Consumers

The estimates from the models using each of the two samples are summarized in Tables 4.3–4.5. Random-effects GLS estimation was desirable from the standpoint of the above-mentioned

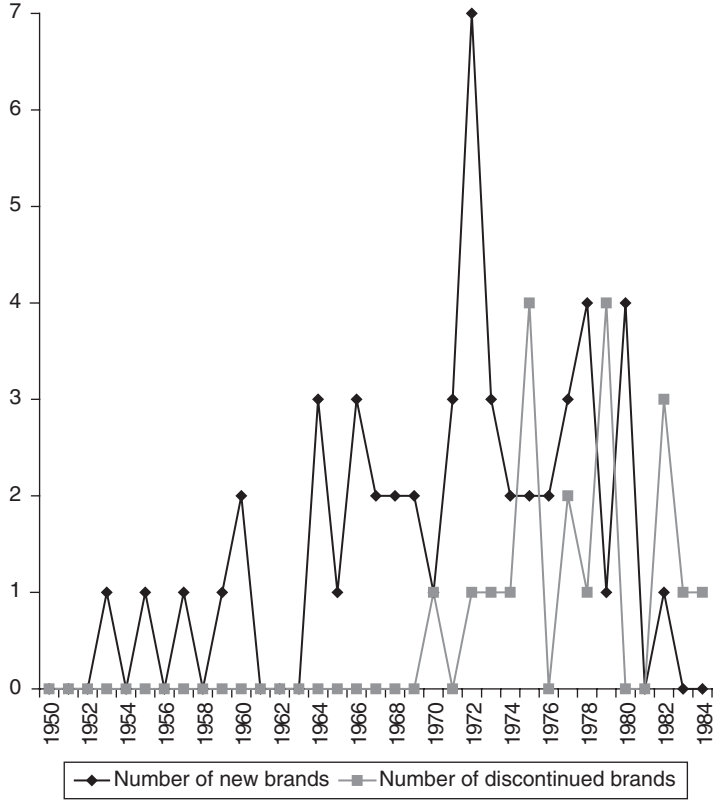


Figure 4.9 Number of discontinued brands versus number of new brands.

measurement errors and the serial correlation of the error terms. Only the results of the random-effects GLS estimation are reported.

Table 4.3 presents the results for the full sample and subsample regressions including nicotine. The coefficient on after64*plain is significantly negative. This suggests that the sales of plain cigarettes decreased significantly. In addition, the coefficient on after67*nicotine is also significantly negative, indicating that the sales of high-nicotine brands decreased significantly, as compared to those of low-nicotine brands, after the introduction of the information disclosure regulations in 1967. Furthermore, the coefficient on after72*nicotine is significantly negative. This means that the greater availability of nicotine information decreased the

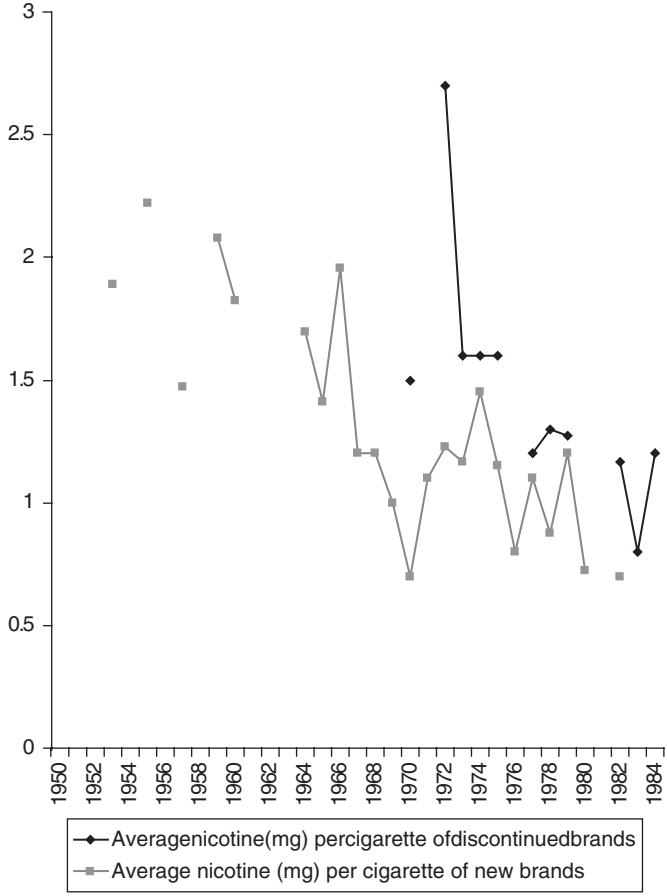


Figure 4.10 Average nicotine (mg) per cigarette of discontinued brands versus that of new brands.

sales of high-nicotine brands after the warning label legislation of 1972. Compared to the estimated coefficients and elasticities of the full-sample regression, those of the subsample regression are only slightly smaller. Therefore, the true estimates should fall between these two results.

Table 4.4 presents results of the full sample and subsample regressions including tar. The coefficient on after64*plain is significantly negative, which suggests that sales of plain cigarettes decreased significantly. In addition, the coefficient on after67*tar

Table 4.3 Estimates with nicotine content

Dependent variable = Demand_per	*Full sample*				*Subsample*			
	Coefficient	*z*	*P > |z|*	*Elasticity*	*Coefficient*	*z*	*P > |z|*	*Elasticity*
Time	−2.05	−0.90	0.37		−3.95	−1.41	0.16	
real price	−666.04	−2.54	0.01	−0.83	−642.37	−2.13	0.03	−0.67
real income	−3.91	−0.46	0.65	−0.65	0.35	0.04	0.97	0.05
after64	238.75	7.59	0.00		242.91	6.98	0.00	
Plain	182.20	2.69	0.01	2.45	173.74	2.48	0.01	1.92
after64*plain	−299.14	−8.97	0.00	−4.02	−299.17	−8.08	0.00	−3.30
after67	213.04	2.67	0.01		194.65	2.18	0.03	
Nicotine	237.62	6.49	0.00	4.58	247.21	5.91	0.00	3.84
after67*nicotine	−115.11	−2.77	0.01	−2.22	−105.71	−2.28	0.02	−1.64
after72	90.86	2.65	0.01		133.89	3.08	0.00	
after72*nicotine	−50.34	−2.69	0.01	−0.97	−84.23	−3.23	0.00	−1.31
Constant	−385.83	−4.07	0.00		−405.38	−3.77	0.00	

Full sample: Random-effects GLS regression, number of observations = 838, number of groups = 55.
R square: within = 0.2811; between = 0.0006; overall = 0.0631.
Subsample: Random-effects GLS regression, number of observations = 688, number of groups = 55.
R square: within = 0.2804; between = 0.0002; overall = 0.0591.
T-statistic is in the *z* column.
GLS, generalized least squares.

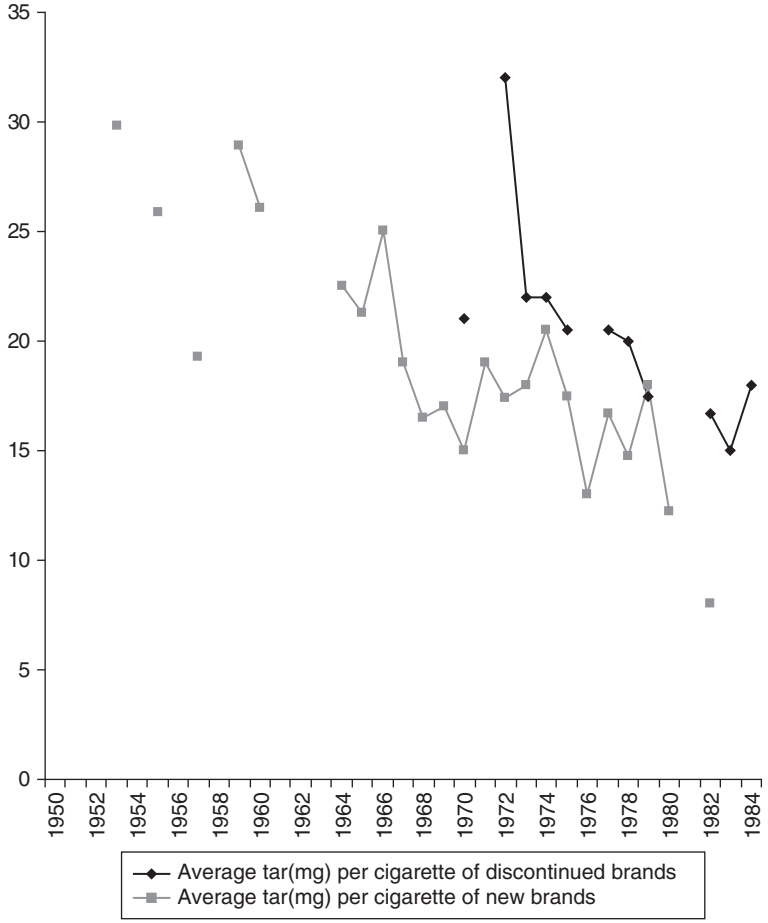


Figure 4.11 Average tar (mg) per cigarette of discontinued brands versus that of new brands.

is significantly positive, indicating that the greater availability of tar information significantly decreased sales of low-tar brands after the information disclosure regulations were introduced in 1967. The coefficient on after72*tar is significantly negative, which implies that the increased tar information decreased sales of high-tar brands following the warning label legislation of 1972. The estimated coefficients and elasticities from the subsample regressions are again only slightly smaller than those from the

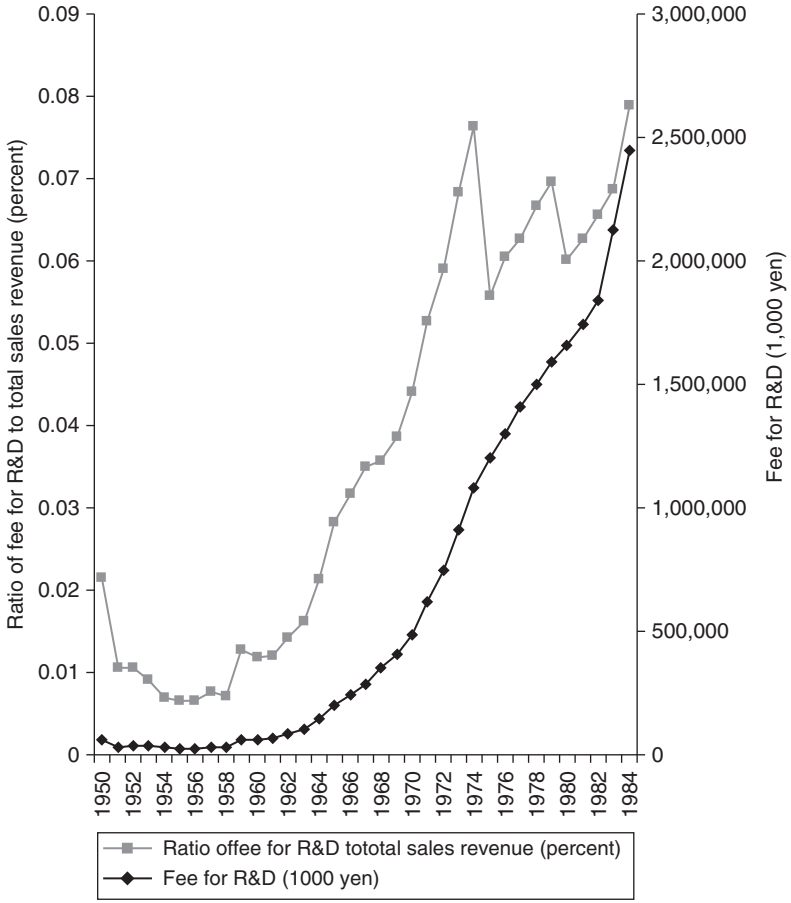


Figure 4.12 R&D costs versus the ratio of R&D costs to total sales revenue.

full-sample regressions. Therefore, the true estimate should lie between estimates derived from the two samples.

Table 4.5 presents further results from the full sample and the subsample regressions. In this instance, the variables for both nicotine and tar content were included in the model. Though there was not a large change in the coefficient on policy information, the elasticity and significance of the coefficient on after72*nicotine, the coefficient on after72*tar, and the coefficient on price changed

Table 4.4 Estimates with tar content

Dependent variable = Demand_per	*Full sample*				*Subsample*			
	Coefficient	*z*	*P > |z|*	*Elasticity*	*Coefficient*	*z*	*P > |z|*	*Elasticity*
Time	−2.32	−0.98	0.33		−5.07	−1.75	0.08	
real price	−1246.94	−4.88	0.00	−1.55	−1259.47	−4.28	0.00	−1.31
real income	−6.29	−0.71	0.48	−1.04	−0.64	−0.06	0.95	−0.08
after64	289.23	8.65	0.00		279.92	7.59	0.00	
Plain	289.50	4.10	0.00	3.89	260.91	3.49	0.00	2.88
after64*plain	−409.37	−11.55	0.00	−5.51	−387.15	−9.91	0.00	−4.28
after67	−272.90	−2.70	0.01		−202.36	−1.79	0.07	
Tar	−1.37	−0.35	0.73	−0.37	3.04	0.67	0.51	0.66
after67*tar	11.24	2.86	0.00	3.01	8.44	1.92	0.06	1.83
after72	116.38	2.49	0.01		199.19	3.24	0.00	
after72*tar	−5.16	−2.48	0.01	−1.38	−9.68	−3.33	0.00	−2.10
Constant	121.73	1.17	0.24		27.35	0.23	0.82	

Full sample: Random-effects GLS regression, number of observations = 838, number of groups = 55.
R square: within = 0.2811; between = 0.0006; overall = 0.0631.
Subsample: Random-effects GLS regression, number of observations = 688, number of groups = 55.
R square: within = 0.2804; between = 0.0002; overall = 0.0591.
T-statistic is in the *z* column.
GLS, generalized least squares.

remarkably. The presence of multicolinearity in these estimates was therefore inferred.

From Tables 4.3–4.5, it can be concluded that the demand for plain cigarettes decreased as a result of the legislation in 1964, that the demand for high-nicotine brands decreased due to the policy event of 1967, and that the demand for high-nicotine or tar brands further decreased as a result of the 1972 regulations.

4.7.2 Impact on the Monopolistic Firm

During the period of voluntary disclosure (before 1967), JT did not disclose content information. In contrast, JT disclosed all information regarding nicotine and tar content during the period of mandatory disclosure (after 1967). Figure 4.7 presents the number of brands on sale and the average annual sales of each brand. The number of brands on sale increased continuously, and the rate of increase became greater after the mid-1960s. Furthermore, the annual average sales of each brand decreased continuously. JT supplied more brands after the introduction of mandatory disclosure. Figure 4.8 presents the number of new plain and filter brands introduced each year. Before 1964, three plain brands were introduced, but after 1964 there were no new plain brands. Only two filter brands were introduced before 1964, but after 1964, 47 filter brands were introduced. Thus, JT supplied more filter brands and fewer plain brands after the policy event of 1964. Figure 4.9 graphs the time transitions of the numbers of discontinued and new brands. It is clear that a remarkably large number of new brands were introduced in 1964, 1967, and 1972. No brands were discontinued before 1972, but many were discontinued thereafter. These facts imply that JT introduced many new brands in response to the events of 1964, 1967, and 1972, and discontinued many brands in response to the policy event of 1972. Figure 4.10 presents the average nicotine contents of both discontinued and new brands. It is clear that the average nicotine content of the discontinued brands was higher than that of the new brands, and this implies that JT discontinued many high-nicotine brands and introduced many low-nicotine brands. Figure 4.11 presents the average tar

Table 4.5 Estimates with nicotine and tar content

Dependent variable = Demand_per	*Full sample*				*Subsample*			
	Coefficient	*z*	*P > |z|*	*Elasticity*	*Coefficient*	*z*	*P > |z|*	*Elasticity*
Time	−2.54	−1.12	0.26		−5.01	−1.79	0.07	
real price	−321.87	−1.19	0.23	−0.40	−358.61	−1.16	0.25	−0.37
real income	−0.70	−0.08	0.94	−0.12	4.41	0.44	0.66	0.57
after64	281.73	8.73	0.00		275.23	7.74	0.00	
plain	273.93	3.89	0.00	3.68	260.48	3.53	0.00	2.88
after64*plain	−353.45	−10.16	0.00	−4.75	−336.87	−8.77	0.00	−3.72
after67	−72.42	−0.71	0.48		−58.43	−0.52	0.61	
tar	−20.78	−4.67	0.00	−5.57	−18.01	−3.39	0.00	−3.91
After67*tar	20.22	3.76	0.00	5.42	19.59	3.28	0.00	4.26
nicotine	340.32	8.07	0.00	6.55	335.75	6.74	0.00	5.21
after67*nicotine	−236.99	−4.21	0.00	−4.56	−234.32	−3.73	0.00	−3.64
after72	118.82	2.41	0.02		247.05	3.89	0.00	
After72*tar	−3.16	−0.68	0.50	−0.84	−12.86	−2.23	0.03	−2.80
after72*nicotine	−28.78	−0.67	0.50	−0.55	11.62	0.22	0.83	0.18
constant	−174.14	−1.62	0.11		−224.82	−1.84	0.07	

Full sample: Random-effects GLS regression, number of observations = 838, number of groups = 55.
R square: within = 0.3423; between = 0.0023; overall = 0.0985.
Subsample: Random-effects GLS regression, number of observations = 688, number of groups = 55.
R square: within = 0.3404; between = 0.0035; overall = 0.0958.
T-statistic is in the *z* column.
GLS, generalized least squares.

Table 4.6 Differences in nicotine and tar content between discontinued brands and brands introduced before and after 1967

	Variable	*Observation*	*Mean*	*Std. dev.*	*Min.*	Max.
Brands discontinued	Nicotine	20	1.42	0.48	0.70	2.70
after 1967	Tar	20	19.65	4.52	12.00	32.00
Brands introduced	Nicotine	13	1.82	0.39	1.35	2.76
before 1967	Tar	13	24.62	3.94	19.30	31.40
Brands introduced	Nicotine	39	1.06	0.30	0.30	1.60
after 1967	Tar	39	16.38	3.60	6.00	23.00

Note: Difference in nicotine content between brands discontinued after 1967 and those introduced after 1967=0.36, *t*-statistic = 3.07, *p*-value = 0.00.

Note: Difference in tar content between brands discontinued after 1967 and those introduced after 1967 = 3.27, *t*-statistic = 2.84, *p*-value = 0.00.

Note: Difference in nicotine content between brands introduced before 1967 and brands introduced after 1967 = 0.76, *t*-statistics = 7.96,*p*-value = 0.00.

Note: Difference in tar content between brands introduced before 1967 and brands introduced after 1967 = 8.24, *t*-statistic = 8.13, *p*-value = 0.00.

contents of discontinued and new brands. It is clear that the amount of tar in the discontinued brands was higher on average than that of the new brands, and this implies that JT discontinued several high-tar brands and introduced many low-tar brands. Figure 4.12 presents JT's R&D behavior. R&D costs versus the ratio of R&D costs to total sales revenue increased continuously, and at an increasing rate, after the mid-1960s. This implies that JT invested in more R&D during the period of mandatory disclosure.

As shown in Table 4.6, after 1967, 20 brands were discontinued, while 39 new ones were introduced; 13 brands were introduced before 1967. The average nicotine and tar content per cigarette of these brands is summarized in Table 4.3. As a result of a difference test, it was determined that the nicotine and tar content of the cigarettes discontinued after 1967 was higher than that of the newer brands. Moreover, it was likewise determined that the nicotine and tar content of brands introduced before 1967 was much higher.

Medical research has verified that low-tar cigarettes are of better quality than high-tar ones, as tar is a cause of cancer; thus, filter cigarettes are of better quality than plain ones because filters

remove some of the tar and other harmful ingredients. In light of previously discussed facts, the characteristics of JT's behavior before and after the mandatory disclosure legislation are clear. In short, JT supplied newer and better quality products, discontinued products of poorer quality, and conducted more R&D in response to the mandatory disclosure regulations.

4.8 Conclusion and Remaining Issues

This chapter presented a new way to test the effects of information disclosure on consumption, and this methodology was used to test the effects of mandatory information disclosure regulations on Japanese interbrand cigarette demand and monopolistic firm behavior.

It was found that the demand for plain cigarettes decreased due to regulation in 1964, and that the demand for high-nicotine brands decreased due to the mandatory disclosure pronouncement of 1967; it was also found that the demand for high-nicotine or high-tar brands decreased due to labeling warnings in 1972. These results are consistent with the time transition of average nicotine and tar per cigarette, the time transition of total nicotine intake, and the tar per capita or per smoker. This suggests that the cigarette consumer experienced a shortage of information before the information disclosure events took place, as the mandatory disclosure of information resulted in a decrease in the intake of tar per capita and per smoker. This implies that mandatory disclosure is likely to decrease the incidence of cancer caused by tar intake and increase consumers' welfare, if we suppose that they always choose their favorite cigarettes.

Compared with the period prior to 1964, JT supplied more filter-tipped brands and ceased production of its new plain brands after the policy event in 1964. It was found that the nicotine and tar content of brands introduced before 1967 was significantly higher than that of new brands introduced after the regulated mandatory disclosure of nicotine and tar information in 1967. It was also found that after 1967, the nicotine and tar content of discontinued brands was significantly higher than that of

introduced brands. In summary, JT supplied more and better quality products, discontinued products of poorer quality, and conducted more R&D in response to the mandatory disclosure regulations.

The policy implications of this chapter are as follows. Mandatory information disclosure is very important and is as indispensable as many other regulations in Japan, such as the "Food Safety Proposal," the JAS law, the Food Sanitation Law, the Product Liability Law, and so on. These regulations are of great significance to the consumer in light of the current lack of information provided to consumers, and they will force monopolistic firms to improve product quality.

In closing, there are two major issues that have not been addressed in this study. The first is that the addictive nature of smoking was not considered in the estimated model. It would be interesting to introduce the effect of information disclosure into the frameworks of Becker et al. (1994) or Wan (2002c). The second issue is that the approach of Yen and Chern (1992) should have been used to estimate information effects. However, when this approach was used, data limitations became a key problem because the dataset has too many brands, too many missing values, and a very short time series.

5

Is Gambling Addictive? Evidence from Pachinko Participation, Quitting, and Reinitiation

5.1 Introduction

Pachinko became popular in Japan during the 1920s.[1] It is still very popular in Japan today and forms the basis of a large industry. A pachinko parlor (or hall or shop) can be found on nearly every street. Based on the "Basic Survey of Service Industries,"[2] a summary and the estimated added value from pachinko parlors are shown in Table 5.1. From this table, we can infer that pachinko is a sizeable service industry. The market volume of pachinko (i.e., sales or revenues of pachinko parlors) was over 28.469 trillion yen (5.6% of the gross domestic product (GDP)) in 1999. Employees of pachinko parlors numbered over 337.36 thousand (0.52% of total employees, 64.62 million persons in 1999), and the added value of pachinko parlors was about 4.385 trillion yen, which contributed 0.86% of GDP in 1999.

Because pachinko is so widely played by the Japanese, it is associated with two social issues: pachinko addiction and household bankruptcy, caused by excessive pachinko playing. According to the reports Survey of Pachinko Addiction,[3] and Survey of Pachinko and Pachinko-Slot Players,[4] about 29% of players considered themselves pachinko addicts in need of medical treatment and about 30% of players exceeded their planned budgets and borrowed money. Figure 5.1 shows the relationship between the likelihood of borrowing money and failing to control

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

Table 5.1 Summary for pachinko industry (by pachinko hall; Unit: 1 million yen.)

	1999	*1994*	*1989*
Total revenue	28,469,278	30,477,786	15,271,233
Total cost	26,490,804	28,799,722	11,424,152
Profit (captital income)	1,978,474	1,678,064	3,847,081
Cost 1: labor cost	1,223,598	1,024,538	561,959
Cost 2: corporation tax	500,000	500,000	500,000
Cost 3: investment on equipment	682,691	584,453	503,876
Added value by pachinko shop	4,384,763	3,787,055	5,412,916
Japanese GDP	508,000,040	491,274,600	414,742,900
Contribution rate (by pachinko shop) to GDP (percent)	0.86	0.77	1.31
Employees in the pachinko shop (persons)	337,364	318,053	222,755

Source: Based on Basic Survey on Service Industry in 1989, 1994, 1999, and the volume of corporation tax.
Note: Data of corporation tax in 1999 is obtained from the Japanese Pachinko Association. There is no data for 1994 and 1989. It is assumed that the volume of corporation tax in 1994 and 1999 are the same as the one in 2000.
GDP, gross domestic product.

one's budget and considering himself or herself a gambling addict. From Figure 5.1, it is very clear that those who thought of themselves as both a pachinko addict and a gambling addict were more likely to borrow money than those who thought of themselves as only a pachinko addict.

From these two direct surveys, it is evident that the social issues related to pachinko playing are very serious. Is pachinko playing really addictive, as found in the aforementioned surveys? Some formal tests are required to answer this question, as respondents might not tell the truth and real addicts might not consider themselves addicts. If it can be shown empirically that pachinko playing is addictive, then some suitable regulatory polices will be needed.

Furthermore, in the framework of economics, pachinko playing is a very interesting case because it is a type of gambling.[5] In the traditional framework, for example, of expected utility with a risk-averse agent, there is no explanation for gambling. This is because the expected return from gambling is significantly negative, but its market price is positive. This seems to be a

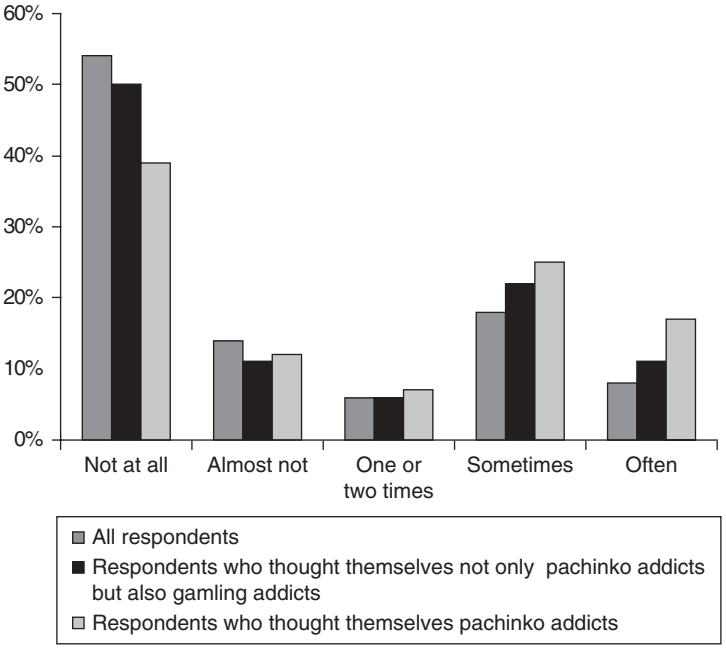


Figure 5.1 Percentage of respondents who have ever exceeded the planned budget and borrowed money.

conundrum. Another explanation for participation in gambling has been offered in the nonexpected utility framework used by Kahneman and Tversky (1979) and in many other works. Although these approaches have been supported, in the main, by experimental economics, there has been little evidence derived from actual data in support of the nonexpected utility hypothesis.

Friedman and Savage (1948) authored a famous theoretical study on gambling in which the concave–convex–concave utility function of wealth (or income) was proposed as an explanation for gambling, within the framework of expected utility. Although empirical analyses, such as that of Brunk (1981), have been conducted regarding this hypothesis, Bailey et al.(1980), and Hartley and Farrell (2002) have pointed out a theoretical problem with the Friedman and Savage hypothesis. In order to analyze participation in gambling, Bailey et al.(1980) extended the Friedman and Savage utility function to two periods, while Hartley and Farrell (2002) extended it to an infinite horizon. In a dynamic

setting, in which the participant considers the long term, these two studies concluded that the Friedman and Savage hypothesis cannot explain even fair gambling unless some severe conditions are imposed; for example, if the financial markets were to fail. Furthermore, as Hartley and Farrell (2002) mentioned, repeated participation in gambling can be explained more easily by the addiction hypothesis, proposed by Becker and Murphy (1988) than by any other hypothesis.

Other literature has provided support for the addiction hypothesis by analyzing smoking, drinking, coffee consumption, and other data. Moreover, Farrell et al. (1999) tested the addiction hypothesis using time-series data for the public lottery in Britain and found evidence to support the addiction hypothesis. Mobilia (1993) also provided evidence to support the addiction hypothesis using time-series data of horse racetracks in the United States. However, to date there has been no research with regard to testing the addiction hypothesis of gambling with individual data.

Thus, a clarification of the preferences of gambling participants is very important. A consensus has not yet been reached with regard to the utility function that should be used to express participants' preferences. In economic theory and empirical economic analyses to date, it has been argued that both expected utility and nonexpected utility are suitable frameworks.[6] If the addiction hypothesis of gambling were to be strongly supported, it would constitute not only an important contribution to the field of economics but also an important contribution to suitable policies for pachinko regulation in the future.

Following Wan (2004f), this research analyzes the pattern of pachinko participation, quitting, and reinitiating behavior during and before 2002; it also provides a description of the playing environment and tests the addiction hypotheses of gambling using individual data from the Japanese Pachinko Survey. I obtained strong evidence to support our conclusion that pachinko playing is addictive.

This chapter consists of five sections. Section 5.2 presents the theoretical framework of myopic addition. Section 5.3 presents the data and estimation technique. Section 5.4 reports the estimation results. Section 5.5 concludes and discusses policy implications.

5.2 Theoretical Framework

A representative consumer is assumed to consume two goods: one is pachinko playing (C_t), and the other is the composite commodity (Y_t). The consumer is assumed to fail to consider the impact of current consumption on future utility and future consumption. Following Fenn et al. (2001), the myopic consumer faces a one-period problem:

$$\begin{aligned} &\max U(C_t, C_{t-1}, Y_t, e_t), \\ &s.t. \quad Y_t + P_t C_t = A_t, \end{aligned} \tag{5.1}$$

where P_t is the price of pachinko playing and A_t is income at time t. The solution is

$$C_t = \eta + \gamma S_{t-1} + \gamma_1 P_t + \gamma_2 e_t, \tag{5.2}$$

where S_{t-1} is the stock of pachinko playing at time t. I make the following hypotheses: H_0: $\gamma > 0$; and H_1: H_0 is not true.

Under the null hypothesis, the consumer is considered addicted to pachinko playing. I will test this hypothesis using four pieces of information, namely pachinko participating, quitting, reinitiating, and the stock of pachinko playing.

5.3 Data and Estimation Methods

5.3.1 Data Source

Data used in this chapter are individual data taken from the Japanese Pachinko Survey, 2003,[7] performed by the Ace Research Institute. The institute has been carrying out the Japanese Pachinko Survey annually since 1995. The candidates chosen for investigation were over 18 years of age at the time of the survey and were randomly selected from the Japanese population. The posting (questionnaire) method is used in this survey, which was conducted in August and September 2002. The number of effective replies (respondents) was 1,508 (863 samples were for participants and players who had quit and nonparticipants, 645 samples were players who had quit).[8] The investigation examined current and past participation behavior, the will to quit or reinitiate pachinko

playing and pachinko-slot playing, as well as other characteristics of the participants, including occupation, sex, age, marital status, and income.

5.3.2 *Information Used for the Empirical Test and Descriptive Statistics*

The questions that are described in detail in Appendix 5A provided the data that were used for econometric analysis. The information regarding participation in the past year, the will to quit now or in the future, the quitter's will to re-initiate after quitting, the duration of non re-initiation after quitting, the status of new players, and age were used to examine the addiction hypothesis. The descriptive statistics for each variable are presented in Table 5.2. The way in which each variable was constructed is described in Appendix 5B.

5.3.3 *Estimation Technique*

Does Participation Increase with Experience?

Interval data for participation frequency over the previous year were available. According to Caudill (1992), OLS estimation using midpoints will not result in a consistent estimator when the dependent variable consists of interval data; therefore, an interval regression based on maximum-likelihood estimation is suitable in this context. With this result in mind, I present and consider an interval regression model. The marginal effect of estimation will be reported.

The dependent variable is participation frequency, or money spent on pachinko playing, or hours of playing pachinko over the previous year. The independent variables are the attributes of the respondents, age, and a dummy variable for new players with less than 1 year experience. Under the null hypothesis, the coefficient of age should be significantly positive, and that of a new player should be significantly negative.

Table 5.2 Summary Statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Non_quitted and quitted, full sample of the first survey					
yearly_times_1	829	20.051	29.971	0	182.5
yearly_times_2	829	42.511	63.896	0	365
yearly_times	829	31.281	46.846	0	273.75
yearly_manyen_1	704	38.329	70.936	0.05	821.25
yearly_manyen_2	704	81.076	150.620	0.15	1642.5
yearly_manyen	704	59.702	110.617	0.1	1231.875
yearly_hours_average_1	707	75.706	141.106	0.125	1186.25
yearly_hours	707	117.567	218.527	0.25	1779.375
yearly_hours_average_2	707	159.428	296.596	0.375	2372.5
pachinko_new	832	0.024	0.153	0	1
female	832	0.296	0.457	0	1
age18_19	832	0.031	0.174	0	1
age20s	832	0.200	0.400	0	1
age30s	832	0.251	0.434	0	1
age40s	832	0.204	0.403	0	1
age50s	832	0.226	0.418	0	1
age60s_over	832	0.088	0.283	0	1
salaried_worker	832	0.458	0.499	0	1
self_employed	832	0.113	0.317	0	1
part_time	832	0.106	0.308	0	1
student	832	0.053	0.224	0	1
housewife	832	0.091	0.288	0	1
public_clerk	832	0.087	0.281	0	1
no_job	832	0.052	0.222	0	1
income_under_2million	832	0.239	0.427	0	1
income_2_4million	832	0.262	0.440	0	1
income_4_6million	832	0.233	0.423	0	1
income_6_8million	832	0.130	0.336	0	1
income_8_10million	832	0.072	0.259	0	1
income_10_15million	832	0.028	0.164	0	1
income_over_15million	832	0.002	0.049	0	1
monthly_allowance_manyen	819	4.425	3.492	0	30
quit_will	832	0.053	0.224	0	1
Full sample of the second survey for quitted					
yearly_past_times	244	16.679	35.512	1	273.75
yealy_past_manyen	235	13.278	42.512	0.1	391.2
yearly_past_hours	244	47.183	143.490	0.5	1231.875
female	294	0.493	0.501	0	1
age18_19	294	0.014	0.116	0	1
age20s	294	0.194	0.396	0	1
age30s	294	0.201	0.401	0	1
age40s	294	0.197	0.399	0	1
age50s	294	0.204	0.404	0	1
age60s_over	294	0.190	0.393	0	1

continued

Table 5.2 Continued

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
salaried_worker	294	0.303	0.460	0	1
self_employed	294	0.095	0.294	0	1
part_time	294	0.160	0.367	0	1
student	294	0.034	0.182	0	1
housewife	294	0.184	0.388	0	1
public_clerk	294	0.071	0.258	0	1
no_job	294	0.075	0.264	0	1
income_under_2million	294	0.374	0.485	0	1
income_2_4million	294	0.224	0.418	0	1
income_4_6million	294	0.133	0.340	0	1
income_6_8million	294	0.116	0.320	0	1
income_8_10million	294	0.051	0.220	0	1
income_10_15million	294	0.034	0.182	0	1
income_over_15million	294	0.003	0.058	0	1
monthly_allowance_manyen	281	3.497	2.556	0	14
reinitiation_will_past	251	1.586	0.712	1	4
Pooled quitted sample					
quit_period	358	6.969	4.324	1	12
manyen_before_quit	342	29.404	88.479	0.1	821.25
female	358	0.436	0.497	0	1
age18_19	358	0.011	0.105	0	1
age20s	358	0.198	0.399	0	1
age30s	358	0.232	0.423	0	1
age40s	358	0.221	0.415	0	1
age50s	358	0.179	0.384	0	1
age60s_over	358	0.159	0.366	0	1
salaried_worker	358	0.332	0.472	0	1
part_time	358	0.137	0.344	0	1
student	358	0.034	0.180	0	1
housewife	358	0.173	0.379	0	1
public_clerk	358	0.075	0.264	0	1
no_job	358	0.078	0.269	0	1
income_under_2million	358	0.344	0.476	0	1
income_2_4million	358	0.237	0.426	0	1
income_4_6million	358	0.162	0.369	0	1
income_6_8million	358	0.126	0.332	0	1
income_8_10million	358	0.050	0.219	0	1
income_10_15million	358	0.028	0.165	0	1
income_over_15million	358	0.006	0.075	0	1
monthly_allowance_manyen	346	3.826	3.442	0	30

Note: The non_quitted and quitted, means the full sample from the first survey; Full sample of the second survey for quitted, means the full sample who quitted in the past year from the second survey; The pooled quitted sample, meand pooled sample who quitted from the first and second survey.

Does the Will to Quit Playing in the Future Increase with Experience?

A probit model is suitable in this instance, and the marginal effect of estimation will be reported. The dependent variable is a dummy variable, which is equal to 1 for the respondent who will quit playing pachinko and 0 for the respondent who will not. The independent variables are participation frequency over the past year and the attributes of the respondents. Under the null hypothesis, the coefficient of the participation frequency should be significantly negative.

Did the Will to Reinitiate After Quitting Increase with the Extent of Experience Just Before Quitting?

Count data for the will to reinitiate after quitting are available, and thus an ordered probit regression model is used. The dependent variable is the will to re-initiate after quitting in the past. Independent variables include experience (participation frequency, payments, and hours) in the year just before quitting. Under the null hypothesis, the coefficient of experience should be significantly positive.

Did the Duration of No Reinitiation After Quitting Decrease with Experience?

Data for duration of no reinitiation after quitting are available, and OLS regression with robust standard errors is used.[9] The marginal effect of estimation is also reported. The dependent variable is the duration of no re-initiation after quitting. Independent variables include payments for pachinko playing in the year just before quitting. Under the null hypothesis, the coefficient of payments should be significantly negative.

5.4 Estimation Results

In Table 5.3, the coefficients for ages 18–19 and in the 30s are not significant, but those for ages in the 40s, 50s, and over-60s are significantly positive. In the first column, the elasticities for ages in the 40s, 50s, and over-60s are 0.093, 0.135, and 0.045, respectively. In the second column, the elasticities are 0.093, 0.135,

Table 5.3 Pachinko participation (Dependent variable = pachinko participation in the past year)

	yearly_times	*yearly_manyen*	*yearly_hours*
pachinko_new	8.634	−4.151	−16.897
	(8.653)	(19.346)	(38.585)
female	−0.776	2.724	−5.966
	(3.739)	(8.943)	(17.915)
age18_19	−1.717	6.766	25.802
	(9.810)	(22.889)	(45.766)
age30s	−2.098	−6.457	−22.798
	(4.017)	(9.759)	(19.574)
age40s	10.136	23.079	39.227
	(4.267)**	(10.285)**	(20.553)*
age50s	13.892	28.945	64.235
	(4.271)***	(10.287)***	(20.581)***
age60s_over	22.658	24.593	32.077
	(6.070)***	(14.256)*	(28.514)
self_employed	4.068	14.949	29.016
	(4.134)	(9.848)	(19.753)
part_time	−3.367	1.064	−3.003
	(5.346)	(12.654)	(25.297)
student	−6.385	−20.890	−56.169
	(8.035)	(19.492)	(39.018)
housewife	4.227	29.084	54.568
	(5.979)	(14.652)**	(29.390)*
public_clerk	1.730	14.015	20.653
	(4.570)	(10.846)	(21.583)
no_job	−12.079	11.436	21.528
	(7.011)*	(16.864)	(33.890)
income_2_4million	1.384	4.105	−7.327
	(4.443)	(10.428)	(20.833)
income_4_6million	3.871	11.872	16.839
	(5.048)	(11.989)	(23.951)
income_6_8million	2.316	5.130	−1.369
	(5.770)	(13.724)	(27.416)
income_8_10million	−1.451	−13.343	−35.849
	(6.733)	(15.773)	(31.547)
income_10_15million	−9.776	−34.569	−97.045
	(8.954)	(21.177)	(41.797)**
income_over_15million	−30.832	−83.737	−156.031
	(24.986)	(77.460)	(155.399)
monthly_allowance_manyen	1.476	6.847	12.377
	(0.386)***	(0.999)***	(2.013)***

continued

Table 5.3 Continued

	yearly_times	*yearly_manyen*	*yearly_hours*
Constant	13.016 (5.465)**	−0.010 (13.196)	23.473 (26.401)
Log likelihood	−2585.742	−2527.464	−2553.394
Observations	804	694	697

Note: *significant at 10%; ** significant at 5%;
***significant at 1%.
Standard error in parentheses.
Estimation method: interval regression.

Table 5.4 Effect of experience on the will to quit (dependent variable = will quit the participation in the future)

	Quit_will	Quit_will
yearly_times	−0.005 (0.002)**	−0.005 (0.002)**
female	−0.066 (0.231)	−0.061 (0.230)
age18_19	−0.690 (0.558)	−0.693 (0.558)
age30s	0.104 (0.250)	0.086 (0.246)
age40s	0.218 (0.263)	0.202 (0.258)
age50s	−0.211 (0.287)	−0.234 (0.284)
age60s_over	−0.401 (0.469)	−0.424 (0.470)
self_employed	0.093 (0.281)	0.094 (0.280)
part_time	0.445 (0.316)	0.466 (0.313)
student	0.600 (0.430)	0.640 (0.428)
housewife	−0.001 (0.409)	−0.001 (0.402)

continued

Table 5.4 Continued

	Quit_will	*Quit_will*
public_clerk	−0.275	−0.280
	(0.371)	(0.371)
no_job	0.217	0.242
	(0.474)	(0.476)
income_2_4million	0.021	0.065
	(0.277)	(0.270)
income_4_6million	−0.400	−0.359
	(0.350)	(0.343)
income_6_8million	0.080	0.136
	(0.373)	(0.365)
income_8_10million	−0.208	−0.130
	(0.465)	(0.441)
monthly_allowance_manyen	0.008	
	(0.027)	
Constant	−1.446	−1.451
	(0.340)***	(0.324)***
Log likelihood	−152.101	−152.681
Observations	698	708

Note: *significant at 10%; **significant at 5%;
***significant at 1%.
Standard error in parentheses.
Estimation method: probit regression.

Table 5.5 Effect of experience on the will of reinitiation after quitting (dependent variable = will of reinitiation after quitting)

	Will of reinitiation after quitting		
yearly_past_times	0.008		
	(0.002)***		
yealy_past_manyen		0.005	
		(0.002)***	
yearly_past_hours			0.001
			(0.001)**
female	0.215	0.105	0.111
	(0.250)	(0.249)	(0.247)

continued

Table 5.5 Continued

	Will of reinitiation after quitting		
age18_19	1.336	1.364	1.358
	(0.961)	(0.960)	(0.959)
age30s	−0.273	−0.224	−0.186
	(0.261)	(0.262)	(0.258)
age40s	−0.279	−0.243	−0.228
	(0.269)	(0.273)	(0.267)
age50s	0.037	0.006	0.107
	(0.277)	(0.282)	(0.276)
age60s	−0.261	−0.107	−0.159
	(0.311)	(0.309)	(0.308)
self_employed	−0.065	−0.142	−0.072
	(0.299)	(0.313)	(0.296)
part_time	0.407	0.408	0.418
	(0.302)	(0.306)	(0.301)
student	0.016	−0.126	−0.100
	(0.796)	(0.793)	(0.794)
housewife	−0.160	−0.291	−0.181
	(0.328)	(0.343)	(0.327)
public_clerk	−0.039	−0.149	−0.041
	(0.335)	(0.339)	(0.333)
no_job	−0.103	−0.136	−0.198
	(0.377)	(0.377)	(0.376)
income_2_4million	0.448	0.407	0.415
	(0.271)*	(0.274)	(0.269)
income_4_6million	0.596	0.555	0.542
	(0.334)*	(0.333)*	(0.332)
income_6_8million	0.214	0.191	0.163
	(0.357)	(0.358)	(0.355)
income_8_10million	0.199	0.287	0.186
	(0.432)	(0.434)	(0.430)
income_10_15million	0.227	0.189	0.092
	(0.565)	(0.562)	(0.559)
income_over_15million	2.619	2.315	2.388
	(1.216)**	(1.205)*	(1.207)**
monthly_allowance_manyen	−0.064	−0.054	−0.054
	(0.037)*	(0.037)	(0.037)
Log likehood	−213.466	−210.306	−217.471
Observations	234	228	234

Note: * significant at 10%; ** significant at 5%; *** significant at 1%.
Standard error in parentheses.
Estimation method: ordered probit estimation.

Table 5.6 Effect of experience on the duration of no reinitiation after quitting (dependent variable = duration of no reinitiation after quitting)

	Quit_period	*Quit_period*	*Quit_period*
manyen_before_quit	−0.005	−0.004	−0.008
	(0.002)***	(0.002)**	(0.001)***
female	0.471	0.246	
	(0.648)	(0.633)	
age18_19	−0.705	−0.899	
	(0.724)	(0.695)	
age30s	1.911	1.667	
	(0.624)***	(0.597)***	
age40s	3.026	2.764	
	(0.685)***	(0.656)***	
age50s	2.794	2.810	
	(0.797)***	(0.775)***	
age60s_over	5.335	5.460	
	(0.664)***	(0.634)***	
part_time	−0.258	−0.378	
	(0.849)	(0.842)	
student	−2.532	−2.687	
	(0.961)***	(0.927)***	
housewife	−0.067	−0.368	
	(0.926)	(0.893)	
public_clerk	0.628	0.578	
	(0.933)	(0.925)	
no_job	1.208	0.648	
	(0.777)	(0.775)	
income_2_4million	−1.028	−1.149	
	(0.810)	(0.783)	
income_4_6million	−1.613	−1.637	
	(0.975)*	(0.950)*	
income_6_8million	−1.194	−1.142	
	(1.087)	(1.005)	
income_8_10million	−1.047	−0.980	
	(1.399)	(1.323)	
income_10_15million	0.170	0.102	
	(1.571)	(1.519)	
income_over_15million	−1.967	−1.993	
	(2.698)	(2.947)	
monthly_allowance_manyen	0.060		
	(0.063)		
Constant	4.913	5.385	7.041
	(0.861)***	(0.836)***	(0.246)***
Observations	332	342	342
R-squared	0.25	0.24	0.02

Note: * significant at 10%; ** significant at 5%; *** significant at 1%.
Standard error in parentheses.
Estimation method: OLS estimation with robust standard errors. OLS, ordinary least squares.

and 0.045, respectively. In the third column, the elasticities are 0.080, 0.151, and 0.030, respectively. If age is a good proxy for pachinko-playing experience, this result is consistent with the addiction hypothesis. However, age might represent only the cohort effect, and thus we cannot say that the significantly positive effect of age strongly supports the addiction hypothesis. We can say that at least this result does not contradict the addiction hypothesis. The dummy for a new player, pachinko-new, is not significant, possibly because of too few samples (only 20 respondents).

The coefficient of yearly-times in Table 5.4 is significantly negative. The elasticities of the yearly-times in the first column and the second column are −0.352 and −0.344, respectively. This result means that the frequency of participation over the previous year significantly decreases the will to quit the activity in the future, and the elasticity is quite large. This is strong evidence in support of the addiction hypothesis.

The estimation in Table 5.5 is for the person who has quit participation for over 1 year. The coefficients of yearly-past-times, yearly-past-manyen (manyen: 10,000 yen), and yearly-past-hours are significantly positive.[10] This is further strong evidence in support of the addiction hypothesis.

The estimation in Table 5.6 is for those who have quit participation over a year ago. The coefficient of manyen-before-quitting is significantly negative. Because real addictive behavior is very difficult to quit, and very easy to reinitiate after quitting, this empirical result is very strong evidence in support of the addiction hypothesis. I have calculated the elasticity. The elasticities in the first, second, and third columns are −0.010, −0.009, and −0.016, respectively.[11]

5.5 Conclusion and Policy Implications

Using a unique dataset taken from the Japanese Pachinko Survey, 2003, this study analyzed the pachinko-participation situation in Japan and tested the addiction hypothesis of gambling. The findings are as follows.

There are large numbers of pachinko participants, and the market volume for the Japanese pachinko industry exceeded 28 trillion yen in 1999; the added value was about 0.86% of GDP. According to the estimated results regarding participation, the will to quit the activity in the future, the will to reinitiate after quitting, and the duration of non-reinitiation after quitting, the addiction hypothesis of gambling is strongly supported. Pachinko-playing experience significantly decreases the will to quit in the future, increases the will to reinitiate after quitting, and decreases the duration of non-reinitiation after quitting.

Therefore, recent and past behavioral patterns of participation in pachinko-playing in Japan are clearly consistent with the characteristics of gambling and addictive behavior. This is a striking result in the context of the empirical analysis of gambling theory. It should be expected that many more theoretical and empirical analyses of gambling are to be conducted in the future, as existing theories have not yet been able to explain gambling.

According to the reports Survey of Pachinko Addiction and Survey of Pachinko and Pachinko-Slot Players, pachinko playing is related to two social issues: pachinko addiction and the probability of household bankruptcy. It is also reported that 29.3% of respondents who think of themselves as a pachinko addict think that they need medical treatment for their addiction. Thus, some suitable regulatory policies are necessary because of its negative externality. For example, the government could set an upper playing bound for heavy pachinko players or make the pachinko parlors monitor heavy players and control their participation or provide medical treatment. Furthermore, in the context of future discussions regarding the regulations and laws related to the pachinko industry, it is expected that the evidence presented here – that pachinko behavior is consistent with gambling and addiction behavior – will become an important material reference for policymakers.

The evidence in this study is also very helpful in reconsidering the assumption of risk aversion, which is one of the most standard (rational agent with risk averse does not participate a gambling with a negative expected return) in modern economics, and in understanding the bubble (fundamentals are a negative expected

return, but a positive market price) as well. I expect there to be more linkages between the bubble and gambling in the future.

The player's "rationality" is not tested here. To test it, a tax or price shock is needed. This issue is left for future research.

Appendix 5A: Data

Main questions used for this study:

Question 1 (for all respondents)

Please circle your frequency of participation over the past year for the following leisure activities:

(1) 5–7 times per week; (2) 2–4 times per week; (3) about once per week; (4) 2–3 times per month; (5) about once per month; (6) about once every 2–3 months; (7) about once every 4–5 months; (8) about once every six months; (9) about once per year; (10) experienced once but did not play during the past year; (11) have no experience; (12) do not know.

Question 2 (For respondents who had played pachinko at least once during the previous year)

On average, what was your expenditure per pachinko game?

_ _ ,_ _ _ yen.

Question 3

How many hours did you play per pachinko game?

(1) Less than 30 minutes; (2) 30 minutes–1 hour; (3) 1–2 hours; (4) 2–3 hours; (5) 3–4 hours; (6) 4–5 hours; (7) 5–8 hours; (8) over 8 hours; (9) I do not know.

Question 17 (For respondents who quit playing pachinko)

When did you play your last pachinko game?

(1) 2002; (2) 2001; (3) 2000; (4) 1999; (5) 1998; (6) 1997; (7) 1996; (8) 1995; (9) 1994; (10) 1993; (11) 1992; (12) before 1991; (13) I do not know.

Question 18 (For respondents who had quit playing pachinko)

Please circle the frequency of your participation over the year before your last pachinko game.

(1) 5–7 times per week; (2) 2–4 times per week; (3) about once per week; (4) 2–3 times per month; (5) about once per month; (6) about once per 2–3 months; (7) about once per 4–5 months; (8) about once per 6 months; (9) about once yearly; (10) I do not know.

Question 63

Compared to the past year, what change will occur in your pachinko participation frequency in the future? Please circle only one choice.

(1) Will increase frequency; (2) no change; (3) will decrease; (4) will quit playing; (5) will reinitiate playing; (6) will not play, like before; (7) I do not know.

Appendix 5B: Construction of the Variables

yearly_times_1: frequency of pachinko participation (times per year, left point of the answer interval)

yearly_times_2: frequency of pachinko participation (times per year, right point of the answer interval)

yearly_times: average of yearly_times_1 and yearly_times_2

yearly_manyen_1: payments for pachinko participation (10,000 yen per year, left point of the answer interval)

yearly_manyen_2: payments for pachinko participation (10,000 yen per year, right point of the answer interval)

yearly_manyen: average of yearly_manyen_1 and yearly_manyen_2

yearly_hours_average_1: hours for pachinko participation (hours per year, left point of the answer interval)

yearly_hours_average_2: hours for pachinko participation (hours per year, right point of the answer interval)

yearly_hours: average of yearly_hours_average_1 and yearly_hours _average_2

pachinko_new: 1 for a respondent with less than 1 year experience with pachinko; 0 for others

female: 1 for a female respondent; 0 for a male

age 18−19? 1 for a respondent who was 18 or 19; 0 for others

age 20s: 1 for a respondent who was 20 or older but less than 30; 0 for others

age 30s: 1 for a respondent who was 30 or older but less than 40; 0 for others

age 40s: 1 for a respondent who was 40 or older but less than 50; 0 for others

age 50s: 1 for a respondent who was 50 or older but less than 60; 0 for others

age 60s_over: 1 for a respondent who was 60 or older; 0 for others

salaried_worker: 1 for a respondent who was a salaried worker; 0 for others

self_employed: 1 for a self-employed respondent; 0 for others

part_time: 1 for a part time worker respondent; 0 for others

student: 1 for a respondent who was a student; 0 for others

housewife: 1 for a respondent who was a full-time housewife; 0 for others

public_clerk: 1 for a respondent who was a civil servant or a clerk in an institution; 0 for others

no_job: 1 for a respondent who had no job; 0 for others

income_under_2million: 1 for a respondent whose yearly income was below 2 million yen; 0 for others

income_2-4million: 1 for a respondent whose yearly income was over 2 million yen but below 4 million yen; 0 for others

income_4-6million: 1 for a respondent whose yearly income was over 4 million yen but below 6 million yen; 0 for others

income_6-8million: 1 for a respondent whose yearly income was over 6 million yen but below 8 million yen; 0 for others

income_8-10million: 1 for a respondent whose yearly income was over 8 million yen but below 10 million yen; 0 for others

income_10-15million: 1 for a respondent whose yearly income was over 10 million yen but below 15 million yen; 0 for others

income_over_15million: 1 for a respondent whose yearly income was over 15 million yen; 0 for others

per month_allowance_manyen: per month allowance (10,000 yen per month)

quit_will: 1 for a respondent who will quit pachinko participation in the future; 0 for others

quit_period: (for respondents who had quit playing) the duration since quitting pachinko participation (in years)

manyen_before_quit: (for respondents who had quit playing) payments for pachinko participation over the year just before quitting playing (10,000 yen per year)

6

Are Gambling and Smoking Complementary? Direct Tests from Japanese Individual Data

6.1 Introduction

Many studies have analyzed smoking and, subsequently, regulations have been made with respect to smoking because of its negative externality (i.e., it is a health hazard). Moreover, other studies have analyzed gambling in Japan and found that pachinko gambling causes an addiction to the game, which often leads to household bankruptcy (Wan 2003). Thus, from the viewpoint of social welfare improvement, suitable regulation policies should be considered. Research linking smoking and gambling behaviors would help to provide policymakers with important information. The lack of such research, linking smoking and gambling, has led us to our current study.

Smoking is a health hazard, but this knowledge does not influence many smokers to quit this seemingly irrational behavior. However, many studies (e.g., Becker, et al. 1994 and Wan 2002a, 2002b) have shown that smoking constitutes a rational addiction behavior. Conversely, gambling has a negative expected return with a positive market price, which begs the question, why do gamblers continue to make bets? Gambling, therefore, also seems to be an irrational behavior. However, certain studies using time-series data such as Mobilia (1993) have found evidence to show that gambling is a rational addictive behavior. Wan (2003),[1]

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

using individual Japanese data, also provides strong evidence that pachinko gambling is addictive.

In economic theory, there have been few works that have analyzed two addictive goods. Dockner and Feichtinger (1993) have demonstrated that there is cyclical consumption path in a continuous time framework when the consumer consumes two addictive goods. A decade ago, Bask and Melkersson (2004) presented a testable model (discrete time), then performed a test for drinking and smoking using Swedish time-series data, and found that alcohol and cigarettes are complementary in nature. Other studies have analyzed two addictive goods using individual data without the addiction framework; for example, Decker and Schwartz (2000) found that alcohol consumption and smoking are complements.

Because smoking is a health hazard, and gambling causes household bankruptcy, a regulation policy may be necessary to compensate for their negative externalities. If research can show that these two goods are complementary behaviors, a regulation policy that might be more effective could be designed. Therefore, I tested whether smoking and pachinko gambling are complements by using a unique individual data set, and I found that not only is smoking complementary to gambling but that gambling is also complementary to smoking.

This chapter consists of five sections. Section 6.2 presents the theoretical framework for two additive goods in discrete time. Section 6.3 presents the data and estimation method. Section 6.4 reports the estimation results. Section 6.5 concludes and discusses policy implications.

6.2 Theoretical Framework

A representative consumer is assumed to consume three goods: the first one is cigarette smoking C_t, the second is pachinko gambling A_t, and the third is a composite commodity Y_t. The consumer is assumed to consider the impact of current consumption on future utility and future consumption. Following Bask and Melkersson

(2004), the rational consumer faces the following problem:

$$\max_{a_t,c_t,y_t} \sum_{t=1}^{\infty} (1+\delta)^{-t} U(a_t, c_t, G_t, H_t, y_t,), \tag{6.1}$$

$$\overline{s.t.} \sum_{t=1}^{\infty} (1+r)^{-t} (y_t + p_{at}a_t + p_{ct}c_t) = W. \tag{6.2}$$

where p_{ct} is the real price of cigarettes and p_{at} is the real price of pachinko playing; G_t and H_t are the respective habit stocks, which measure the degree of addiction. r is the interest rate and the W is the present value of wealth. δ is the factor of time preference, which is assumed be positive and equal to r. The solution is[2]

$$\begin{aligned} a_t = {} & \beta_{10} + (1+r)\beta_{11}a_{t-1} + \beta_{11}a_{t+1} + \beta_{12}c_{t-1} \\ & + \beta_{13}c_t + \beta_{14}c_{t+1} + \beta_{15}p_{at}, \end{aligned} \tag{6.3}$$

$$\begin{aligned} c_t = {} & \beta_{20} + (1+r)\beta_{21}c_{t-1} + \beta_{21}c_{t+1} + \beta_{22}a_{t-1} \\ & + \beta_{23}a_t + \beta_{24}a_{t+1} + \beta_{25}p_{ct}. \end{aligned} \tag{6.4}$$

According to these two demand equations, we can predict the signs of the parameters. If cigarette smoking and pachinko playing are independent, β_{12}, β_{13}, β_{14}, β_{22}, β_{23}, and β_{24} must be zero. If cigarette smoking and pachinko playing are complements, $\beta_{13} > 0$ and $\beta_{23} > 0$, but the signs of β_{12}, β_{14}, β_{22}, and β_{24} are undecidable. If cigarette smoking and pachinko playing are substitute goods, $\beta_{13} < 0$ and $\beta_{23} < 0$ but the signs of β_{12}, β_{14}, β_{22}, β_{24} are also undecidable. Thus, to test whether cigarette smoking and pachinko plaing are complements or substitutes, the useful parameters are only β_{13} and β_{23}. I will perform two direct tests for these two useful parameters by using a unique individual dataset.

6.3 Data and Estimation Technique

6.3.1 Data Source

Characteristic 1 is that this dataset is opened in the Social Science Japan Data Archive, Institute of Social Science, University of Tokyo. Anyone can access this data with an application. Characteristic 2 is that there is detailed information about

pachinko participation, smoking, shops that ban smoking, smoking when playing, etc., that are summarized in tables 6.1–6.5.

Data used in this chapter are individual data taken from the Japanese Pachinko Survey, 2003, performed by the Ace Research Institute. The institute has been carrying out the Japanese Pachinko Survey annually since 1995. The candidates chosen for investigation are randomly selected from the Japanese population, aged 18 and over at the time of the survey. The posting (questionnaire) method was used in this survey, which was conducted in August and September 2002. The number of effective replies (respondents) was 1,508.

6.3.2 Information Used for Empirical Tests

The data used for the hypothesis test came from the Japanese Pachinko Survey, 2003, which is described in detail in Appendix 5A–5B of Chapter 5. Information about pachinko playing in the past year, the habit of smoking, the status of smoking when playing pachinko, the desire to play pachinko in a smoke-free facility, etc., are used to identify the hypothesis.

6.3.3 Methods

To show whether participation is positively correlated with the habit of smoking, two cross tables (Tables 6.1 and 6.2) are used to clarify it. The correlations can be easily shown by the two tables. To show whether an increase in smoking is conditional upon playing pachinko, I also used an additional table (Table 6.3) to clarify it.

To show whether the desire to play pachinko in a smoke-free facility decreases because of a lack of opportunity to smoke, I used Table 6.4 to show the desire and used a cross table (Table 6.5) to show their relationship. Then, I performed 3 ordered probit estimations to test the hypothesis.

Table 6.1 Participation in pachinko versus status of smoking

Participation in pachinko	*Status of smoking*				*Total*
	Smoke	*I quit*	*I do not smoke*	*I do not know*	
2 ~ 7 times weekly	47	10	19	0	76
About once weekly	78	7	41	0	126
2 ~ 3 times monthly	80	17	36	0	133
About once monthly	64	17	53	1	135
About once per 2 ~ 3 months	59	20	41	1	121
About once per 4 ~ 12 months	95	20	128	0	243
1 ~ 2 years ago	101	23	137	2	263
3 ~ 5 years ago	141	56	235	0	432
6 ~ 10 years ago	141	57	344	0	542
Over 11 years ago	291	105	966	3	1,365
Have no experience	177	50	1,444	5	1,676
I do not know	33	4	40	0	77
Total	1,307	386	3,484	12	5,189

Source: Japanese Pachinko Survey, 2003.

Table 6.2 Participation in pachinko-slot versus status of smok ing

Participation in pachinko-slot	*Status of smoking*				
	Smoke	*I quit*	*I do not smoke*	*I do not know*	
2 ~ 7 times weekly	39	3	12	0	54
About once weekly	35	2	12	0	49
2 ~ 3 times monthly	41	7	14	0	62
About once monthly	36	11	22	0	69
About once per 2 ~ 3 months	44	8	31	0	83
About once per 4 ~ 12 months	58	6	56	0	120
1 ~ 2 years ago	77	24	75	1	177
3 ~ 5 years ago	93	34	130	1	258
6 ~ 10 years ago	103	27	163	0	293
Over 11 years ago	139	39	280	2	460
Have no experience	522	196	2,491	7	3,216
I do not know	120	29	198	1	348
Total	1,307	386	3,484	12	5,189

Source: Japanese Pachinko Survey, 2003.

Table 6.3 Status of smoking when playing pachinko

	Frequency	*Percentage*	*Cumulative*
I increase smoking compared to other times	300	40.43	40.43
I smoke little but smoke when playing	52	7.01	47.44
I never smoke when playing	349	47.04	94.47
I do not know	41	5.53	100
Total	742	100	

Source: Japanese Pachinko Survey, 2003.

Table 6.4 The will to go to a pachinko shop with a smoking ban

	Frequency	*Percentage*	*Cumulative*
I would love to go to the shop	154	20.75	20.75
I may go to the shop	202	27.22	47.98
I do not want to go to the shop	168	22.64	70.62
I do not want to go to the shop at all	184	24.8	95.42
I do not know	34	4.58	100
Total	742	100	

Source: Japanese Pachinko Survey, 2003.

6.4 Empirical Results

Analyzing Tables 6.1 and 6.2, it is clear that participation in pachinko and pachinko-slot are positively correlated. But we cannot know the causality; in other words, does pachinko playing increase smoking, or does smoking increase pachinko playing?

Table 6.3 analyzes the direct question put to pachinko players: What is your smoking status when you are playing pachinko? This constitutes a correspondent to the demand equation (6.4): $E(c_t|a_t)$. Respondents were asked to circle one of four replies: (1) "I smoke more, as compared to other times"; (2) "I smoke infrequently, generally, but smoke when playing"; (3) "I never smoke"; and (4) "I do not know." The percentage of respondents circling the first choice was 40.43, while 7.01% of respondents circled the second reply. These results provide strong evidence that pachinko playing increases smoking and imply that smoking is complementary to gambling.

Table 6.5 Status of smoking when playing versus the will to go to a pachinko shop with a smoking ban

	Will to go to a pachinko shop with a smoking ban					
Status of smoking when playing	I would love to go to the shop	I may go to the shop	I do not want to go to the shop	I do not go to the shop at all	I do not know	Total
I increase smoking when playing	4	44	108	144	0	300
I smoke little but smoke when playing	3	13	24	12	0	52
I never smoke when playing	146	144	34	23	2	349
I do not know	1	1	2	5	32	41
Total	154	202	168	184	34	742

Source: Japanese Pachinko Survey, 2003.

Table 6.4 analyzes the direct question put to pachinko players: Would you go to a pachinko facility that bans smoking? This question constitutes a correspondent to the demand equation (6.3): $E(a_t|c_t)$. Respondents were asked to circle one of five replies: (1) "I would love to go to a smoke-free pachinko facility"; (2) "I might go to such a facility"; (3) "I would not want to go to such a facility"; (4) "I do not want to go to such a facility at all"; and (5) "I do not know." The percentages for each answer are, respectively, 20.75, 27.22, 22.64, 24.8, and 4.58. Table 6.5 is a cross–table that indicates the questions in Tables 6.3 and 6.4. Clearly, respondents who circled the first answer in Table 6.3 were likely to circle the fourth answer in Table 6.4, while respondents who circled the third answer in Table 6.3 were likely to circle the first answer in Table 6.4. These results provide strong evidence that the desire to play pachinko in a smoke-free facility decreased because of a lack of opportunity to smoke, and imply that pachinko is complementary to smoking.

I used information in Tables 6.3 and 6.4 to perform 3 ordered probit estimations. The dependent variable was equal to five for the respondents who circled the first answer, four for the second answer, three for the third answer, two for the fourth answer, and one for the fifth answer in Table 6.4. I also made two dummies to catch the information in Table 6.3. Smoking-much-pachinko is equal to one for respondents who circled the first answer in Table 6.3, and zero for the other. Smoking-pachinko is equal to one for respondents who circled the second answer in Table 6.3, and zero for the other. The estimated results are summarized in Table 6.6. The coefficients of smoking-pachinko and smoking-much-pachinko are all significantly negative. Furthermore, the absolute value of the coefficient of smoking-much-pachinko is significantly lager than that of smoking-pachinko. These results strongly support the idea that the desire to play pachinko in a smoke-free facility decreased because of a lack of opportunity to smoke and imply that pachinko is complementary to smoking.

Table 6.6 Determinants of the will to go to a pachinko shop with a smoking ban

Independent variable	*Dependent variable = the will to go to a pachinko shop with a smoking ban*		
smoking_much_pachinko	−1.823	−1.792	−1.747
	(0.106)***	(0.103)***	(0.099)***
smoking_pachinko	−1.220	−1.191	−1.195
	(0.167)***	(0.165)***	(0.163)***
pachinko_exper	0.018		
	(0.018)		
female	0.100	0.087	
	(0.135)	(0.134)	
age18_19	−0.062	−0.046	
	(0.296)	(0.296)	
age30s	−0.033	−0.019	
	(0.140)	(0.137)	
age40s	−0.278	−0.199	
	(0.149)*	(0.146)	
age50s	−0.140	−0.110	
	(0.149)	(0.146)	
age60s_over	−0.353	−0.378	
	(0.213)*	(0.208)*	
self_employed	0.135	0.134	
	(0.145)	(0.142)	
part_time	−0.465	−0.407	
	(0.190)**	(0.186)**	
student	−0.439	−0.420	
	(0.274)*	(0.273)	
housewife	−0.462	−0.489	
	(0.220)**	(0.214)**	
public_clerk	0.181	0.203	
	(0.157)	(0.157)	
no_job	0.179	0.210	
	(0.245)	(0.242)	
income_2_4million	−0.115	−0.078	
	(0.159)	(0.155)	
income_4_6million	−0.322	−0.290	
	(0.183)*	(0.177)	
income_6_8million	−0.324	−0.323	
	(0.209)	(0.201)	
income_8_10million	−0.327	−0.395	
	(0.239)	(0.227)*	
income_10_15million	−0.305	−0.372	
	(0.320)	(0.310)	

continued

Table 6.6 Continued

Independent variable	*Dependent variable = the will to go to a pachinko shop with a smoking ban*		
income_over_15million	−0.139	−0.241	
	(1.091)	(1.084)	
monthly_allowance	−0.037		
	(0.015)**		
Observations	683	708	708
Log likelihood	−775.247	−796.419	−807.048
Pseudo R square	0.194	0.186	0.175

Note:* significant at 10%; **significant at 5%; *** significant at 1%.
Standard errors in parentheses.
Estimation method: ordered probit.

6.5 Conclusion and Policy Implications

I have used a unique individual dataset to clarify the relation between pachinko gambling and smoking. I have demonstrated not only their positive correlation, but also their causality. Pachinko gambling increases smoking; thus, smoking is complementary to gambling. On the other hand, the desire to play pachinko in a smoke-free facility decreased, owing to a lack of opportunity to smoke; thus, pachinko is also complementary to smoking.

Because smoking and pachinko gambling have strong negative externalities (e.g., smoking is a health hazard and gambling often causes household bankruptcy in Japan), a number of regulation policies (such as a public smoking ban) are needed. Moreover, because of the complementary nature of the two behaviors, the effect of regulation would be twofold.

Despite my initial research, the field of modern standard economics does not provide answers to behavioral questions such as, Why do gamblers wager to the point of personal bankruptcy? Why does a bubble always occur in the price of stock and land? and Do participants in gambling or in the stock market have a stable preference? Perhaps gamblers consume two addictive goods, as I have shown in this study. A gambler's preference to wager may be influenced by other activities, as is smoking. Thus, it is helpful to reconsider participants' attitudes to risk (uncertainty in gain). In

this study, the complementarity of two addictive goods has been clarified, but their addictiveness and stability have not been tested. For example, when β_{13} and β_{23} are sufficiently large, the system equations (6.3) and (6.4) may be unstable. These issues remain to be investigated by future research.

7

Tax Revenue in China and the Incentive to Declare Taxes: The Lottery Receipt Experiment[1]

7.1 Introduction

7.1.1 The Light and Shadow of China's Economy

China's economy shifted to a market economy in 1978 to include the rural contract work system and private companies as pointed by Lin (1992). Stock markets and special economic zones were founded in the 1980s. In 1994, decentralization separated the local and central governments, including the taxation system. As shown in Figure 7.1, after the 1978 shift to a market economy, high growth was realized for more than 20 years. In 2003, China experienced 8% economic growth, and achieved over 9% growth in 2004. However, as shown in Figures 7.2 and 7.3, the budget deficit has become a serious concern and total revenues are decreasing. Moreover, Figure 7.4 shows the transition of Gini's coefficient, which measures the degree of economic inequality in China. Clearly, the degree of economic inequality in China is growing. To sustain future economic growth, these two significant issues must be resolved. The implementation of an efficient and fair tax collection system might serve as an effective and reasonable means toward solving China's economic problems; however, at present, the country lacks such a tax collection system. Economists have warned of the seriousness of the deficit and inequality issues in China. In February 2004, Shiller (2004) provided six pieces of advice regarding the Chinese economy,[2] and his first recommendation was the creation of an effective taxation system.

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

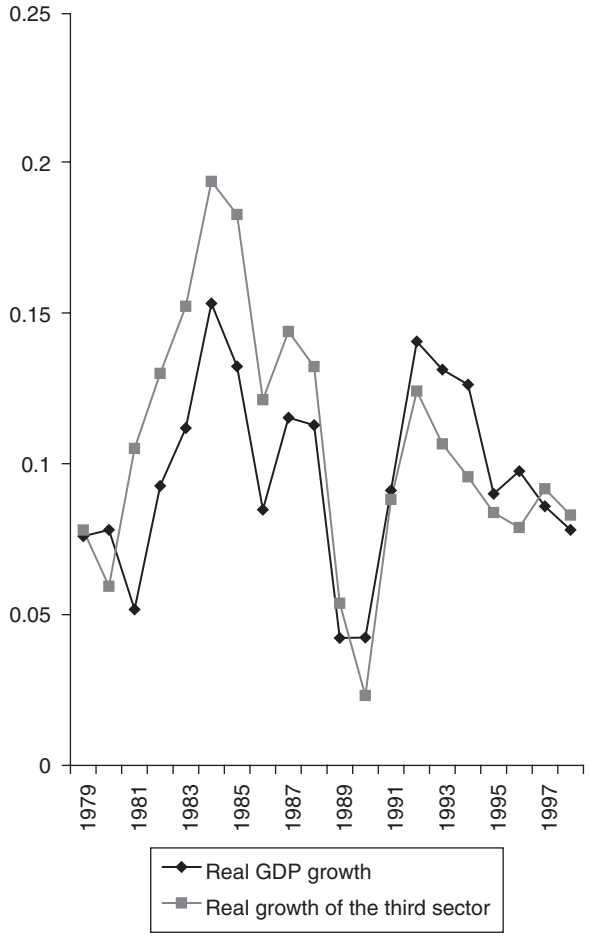


Figure 7.1 Real growth in China.

Similarly, Krugman (2004) noted that "since there is no tax collection system anyway, a possibility that the China government itself will go bankrupt is not zero, either."[3]

7.1.2 Issues in Taxation

Even if the government understands the importance of tax collection, if the technical and intellectual ability to create a tax collection system is lacking, the effort will fail. To collect an operating tax or sale tax (similar to a consumption tax, i.e.,

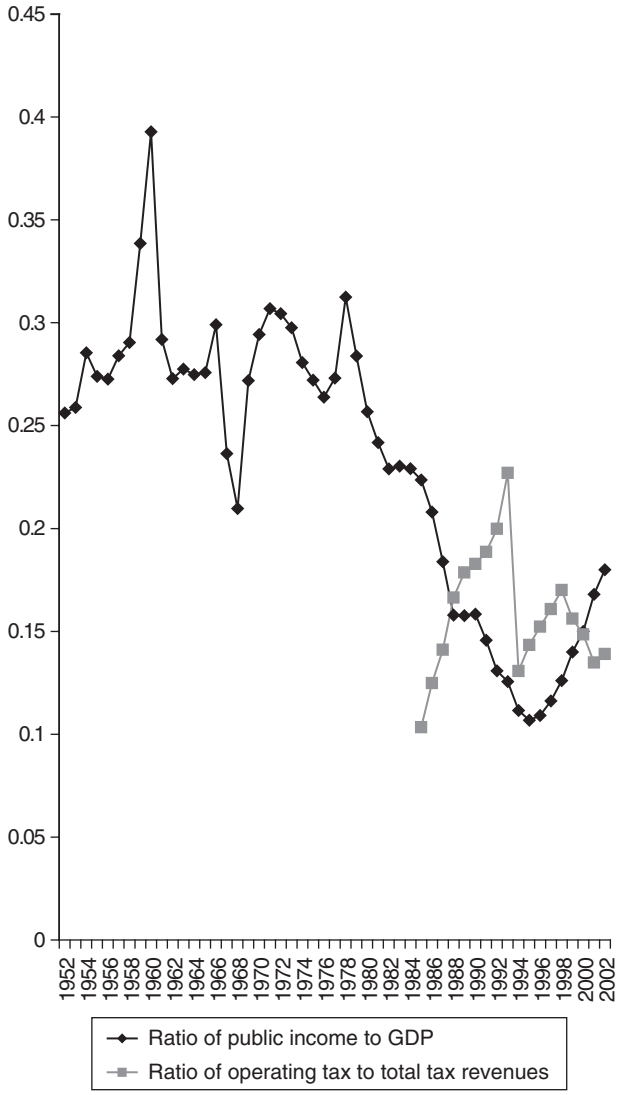


Figure 7.2 Ratio of public income to GDP and ratio of operating tax to total tax revenues in China.

about five percent of total sales), income tax, and wealth tax, the government needs to obtain private and corporate financial records of transactions, income, and wealth. However, unless the government is willing to pay the significant cost of monitoring the

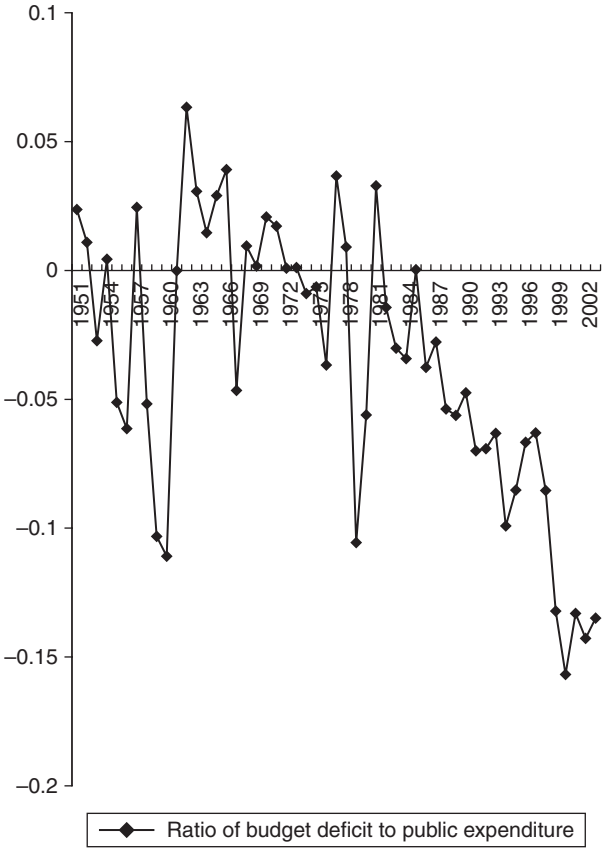


Figure 7.3 Budget deficit in China.

collection process, such information will not materialize. Owing to the asymmetry of information between the government and the taxpayer, individuals might be tempted to underreport the amount of taxes due. For example, there is the issue of kuroyon in Japan, which refers to the fact that the rates of income recorded for salaried workers, farmers, the self-employed, and politicians are about 90%, 60%, 40%, and 10%, respectively. The taxation issue is often a point of contention in Japan and it has been studied for many years. In relation to the "kuroyon issue," it has been hotly debated in Japan whether a corporate enterprise tax system based

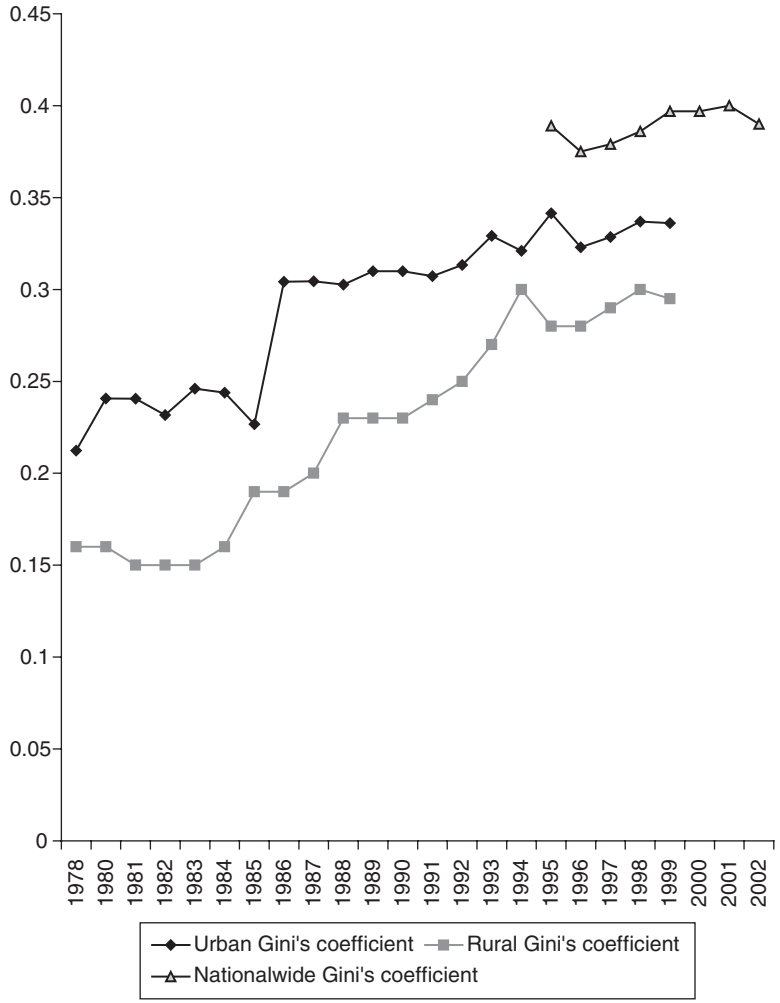


Figure 7.4 Gini's coefficient in China.

on sales, salary, etc., and a taxpayer numbering system should be introduced; however, this argument does not progress easily. When building a tax collection system, a government must make taxpayers cooperate in providing accurate financial information and must design and provide an incentive mechanism that can mitigate informational asymmetry.

7.1.3 Tax Evasion in China

For many years, mainland China has been wrestling with the issue of capturing a fair tax base as argued by Fisman and Wei (2004). The government first issued a guideline requiring a lottery receipt for economic transactions (You Jiang Fa Piao, in Chinese) as a means of anti tax evasion. Lottery receipt is an official receipt printed with lottery, thus, a receipt is simultaneously as a lottery for raising a consumer's incentive to ask for receipt.[4] The first experiments with the lottery receipt procedure were held in certain areas on March 4, 1989.[5] Discussion and preparation took 10 years prior to the launch of the experiment. On January 1, 1998, the new receipt system came into effect in Haikou City, Hainan Province, which is one of the most open cities in China. The central government evaluated the system's performance and has since increased the trial area incrementally across the nation. According to my research in May 2003 using the search engine Google.com, by the end of 2002, there were over 80 big-city-level local tax bureaus countrywide (out of approximately 662) where the experiment were underway. In other words, 12% of local tax bureaus were conducting the lottery receipt experiment (see Table 7.1). In 2013, nearly all areas in mainland China started the lottery receipt experiment(hereafter LRE).[6]

Accompanying the LRE, the Act of China Taxation was revised, and since May 1, 2001, the New Act of China Taxation has been enacted. The detailed enforcement rules for the new act came into effect on October 15, 2002. A new 23rd article has since been added to the new act, which provides that "the equipment which prevents tax evasion should be actively repaired." Specifically, this "equipment which prevents tax evasion" is a patented machine that issues a lottery number to a receipt for all economic transaction.[7]

The experiments were conducted in depth in three of China's largest cities: Beijing, Shanghai, and Tianjin. In Beijing, one district (out of 18) has conducted the experiment since January 1, 2001; seven districts since August 1, 2002; and the remaining 10 districts have issued lottery receipts since October 1, 2002. At first, mainly service industries, such as food service businesses issued receipts

Table 7.1 Areas with lottery receipt experiment in China

	Number of districts (cities)	*Number of districts (cities) with lottery*	*Rate of experiment (percent)*
Nationwide	2858	228	7.98
Beijing	18	18	100
Tianjin	18	0	0
Hebei	172	16	9.3
Shanxi	119	0	0
Neimenggu	101	0	0
Liaoning	100	28	28
Jiling	60	5	8.33
Heilongjiang	130	11	8.46
Shanghai	20	20	100
Jiangshu	108	0	0
Zhejiang	88	0	0
Anhui	106	4	3.77
Fujian	84	13	15.48
Jiangxi	99	18	18.18
Shandong	139	25	17.99
Henan	158	7	4.43
Hubei	101	13	12.87
Hunan	122	9	7.38
Guangdong	122	26	21.31
Guangxi	110	0	0
Hainan	20	3	15
Congqing	40	1	2.5
Sichuan	180	0	0
Guizhou	86	5	5.81
Yunan	128	4	3.13
Xizang	73	0	0
Sanxi	107	0	0
Ganshu	86	5	5.81
Qinghai	43	0	0
Ningxia	24	0	0
Xinjiang	96	0	0

Note: Author's search using the search engine Google.com in May 2003. It is not statistical data; some notes are needed.

with lottery transactions. However, in Shanghai, the experiment began in October 1, 2002, and since January 1, 2003, it has grown to include other service industries such as beauty salons and real estate agencies. In Tianjin, the experiment began on January 1, 2004. Today, the scope of areas conducting the lottery receipt experiment has expanded to many.

In this chapter, I first analyze theoretically whether the new taxation system in China is well run, and then I empirically examine the effect of the new system on tax collection using the "natural experiment" method based on panel data consisting of experimental and nonexperimental areas. I found that the new system will work well, even if the consumer has quasilinear preference and expected utility. In addition, I found that the LRE has caused operating (sales) tax revenues to increase significantly.

The structure of this chapter is as follows: Section 7.2 discusses a theoretical framework. Section 7.3 describes the data, model, and the method of econometric estimation. Section 7.4 shows the results, and Section 7.5 discusses the policy implications and concludes the chapter.

7.2 Theoretical Framework

7.2.1 Lottery Transaction[8]

Morgan (2000) presented a mechanism for financing public goods by means of a taxable lottery for consumers with quasilinear preferences. Morgan's mechanism proved to be more efficient than a voluntary taxpayer system with regard to raising funds for welfare improvement. Morgan and Sefton (2000) further confirmed this theory. Prior to these studies, Friedman and Savage (1948) and Kahneman and Tversky (1979) analyzed lottery purchases; however, they did not consider the issue of producing a lottery for a receipt for transactions as a way to track taxable volume of sales.

7.2.2 Mechanism of Tax Declaration by Lottery Receipt System in China

Issues of Tax Evasion Caused by Information Asymmetry

In economic transactions, there are three types of agents: the firm, the consumer, and the government. It is assumed that there are infinite homogeneous firms, and that these firms seek profit maximization within a competitive market. It is also assumed that there is a sufficiently large and homogeneous body of

consumers. When a consumer buys a product from a firm, the information on the purchased quantity "V" is shared with the company. The government cannot know about this sale unless it applies a sufficiently large monitoring cost. Although social public welfare will increase if all consumers pay their taxes voluntarily, the consumer has an incentive not to pay taxes because the government cannot supervise the trading volume between the consumer and the firm. It is assumed that the government collects, to the highest extent, sales tax T according to the purchased amount V, but that it cannot perform proper accounting unless it has correct information regarding the correct amount of V. However, the cost of monitoring V is larger than the information value of V and the tax revenues T. Therefore, the government will not act as the monitor of V and cannot fully collect the tax T.

Purchase of Public Lottery

In the setting of above section, the governemnt cannot collect sales tax because the information on transaction volume cannot be obtained. Here, government is assumed to sell public lottery for financing public goods. It is also assumed that the government collects taxes on lottery transactions by issuing a receipt with purchase. I analyzed consumers' purchase of lottery tickets using Morgan's framework (2000).[9] In this framework, the government sells fixed-prize raffle tickets (the prize amount is R) and informs each consumer of R in advance. Consumer i has wealth w_i and a quasilinear preference. There are N consumers in this economy. Consumer i optimally chooses the amount to purchase $x_i \in [0, w_i]$, conditional on the fact that the purchases of other consumers are given. The probability of winning the prize is set to $x_i/x(N)$, and $x(N) = x_1 + \ldots + x_N$. The net revenues to the government for offering pure public goods is $G = x(N) - R$. The sales $x(N)$ of the lottery are assumed to be large enough to cover the prize R. The problem of lottery purchase for consumer i can be set as the following expected utility maximization:

$$EU_i = w_i - x_i + [x_i/x(N)]R + h_i[x(N) - R], \tag{7.1}$$

where h_i is consumer i's utility from pure public goods. The first-order condition with respect to x_i is

$$[x_i/((x(N))^2]R - 1 + h_i'[x(N) - R] \leq 0. \tag{7.2}$$

In equilibrium, N' consumers will purchase the amount $(x_i^*, \ldots, x_{N'}^*)$ of lottery tickets, respectively. If the first-order conditions of N' consumers are added, we get

$$\sum_{i=1}^{N'} h_i'[x^*(N') - R] - N' + (N' - 1)[R/x^*(N')] = 0. \tag{7.3}$$

When the prize R is increased, the effect of prize R on the lottery sales x^* and on the net government revenues are, respectively,[10]

$$\frac{\partial x^*(N')}{\partial R} \geq 1, \tag{7.4}$$

$$\frac{\partial G}{\partial R} = \frac{\partial x^*(N')}{\partial R} - 1 \geq 0. \tag{7.5}$$

As shown in equations (7.4) and (7.5), increasing the prize does not reduce the sales x^* and the governmental net revenue G, but it is unclear here whether the prize definitely increases G. Hence, it is necessary to clarify this property empirically.

I consider that $R = 0$ in areas where the LRE is not being conducted; thus equation (7.5) can express the difference in tax revenues between areas where the experiment is and isn't

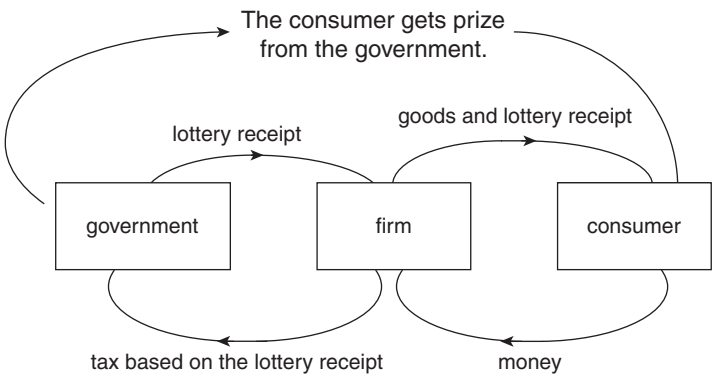


Figure 7.5 Framework of the delivery of the lottery receipt in China.

being conducted. Moreover, comparison within the areas of experiment is also possible, and according to equation (7.5), tax revenue in the areas of the experiment with large prizes is likely to be larger than (or equal to) that in areas of experiment with lower prizes. Section 7.3 examines the effect of the lottery receipts; in other words, whether $\partial G/\partial R \geq 0$ is true.

Figure 7.5 shows the framework of the delivery of lottery receipts and the behaviors of the government, the firm, and the consumer.

7.3 Empirical Examination

7.3.1 Probability of Winning a Prize, Amount of Prize, and the Dataset

To announce the amount of the prize beforehand can be considered a strategy of the government. For example, according to the predraw prize announcement by the Beijing Local Tax Bureau on July 17, 2002,[11] the total prize money amounted to 3 million Renminbi (1 U.S. dollar $\approx$ 6.5 Renminbi in 2002) in August and September, and 10 million Renminbi between August and December 2002. However, ex post facto, the total prize money paid out to the 67,129 winners in the whole city during 2002 was 1.67 million Renminbi. The total actual prize was therefore only 16.7 percent of the announced prize.[12] Moreover, the predrawing prize announcement of the probability of winning the prize (namely, the ratio between the prize and the tax revenue) is a strategy of the government.

According to a report of the China Taxation Bureau on July 30, 2002,[13] the total prize amount paid out in all of the experimental areas throughout China was 30 million Renminbi, and the increase in tax revenues brought about by the lottery receipts was 900 million Renminbi between January 1 and June 30, 2002. The ratio of the prize to tax revenues (which can be seen as a kind of input-output ratio) was about 1:30. In the experiment in the Huairou District of Beijing in 2001, 0.14 million Renminbi was paid out in prizes and the tax revenue of 6 million Renminbi was increased owing to providing a lottery receipt.

The prize tax revenue ratio was about 1:40. Many Chinese mass media outlets announce information regarding the prizes. Because detailed information on prizes at the provincial or state level for the entire country could not be obtained, I could not perform an econometric analysis at the provincial level.

There are 18 districts in Beijing. Huairo, Chaoyang, Shunyi, Fengtai, Fangshan, Pinggu, Shijingshan, and Miyun have issued receipts with lottery transactions since August 1, 2002. The other ten districts began issuing receipts on October 1, 2002. Therefore, the effect of the experiment on tax revenues can be estimated by district-level panel data (18 districts, 5 years, before and after the experiments).

Table 7.2 Main indicators in Beijing and Tianjin

2002	*Beijing*	*Tianjin*
Population	14.253 million	9.191 million
GDP	321270 million Renminbi	205120 million Renminbi
Per capita GDP	22541 Renminbi	22380 Renminbi
Growth rate of per capita GDP	0.8	0.11
Total tax revenue	53400 million Renminbi	37590 million Renminbi

Note: GDP, gross domestic product.
Source: Beijing Statistic Yearbook 2003, Tianjin Statistic Yearbook 2003.

Table 7.3 Summary of the main variables

Variable	*Observation*	*Mean*	*Std. dev.*	*Min*	*Max*
year	195	2000.000	1.418	1998.000	2002.000
id	195	20.000	11.284	1.000	39.000
total_revenues	195	63827.230	88999.830	8227.000	528356.000
operation_tax	195	24756.060	38711.560	1617.000	225,000.000
population	185	59.871	40.369	0.380	254.600
total_revenues_rate	148	0.174	0.225	−0.353	1.410
operation_tax_rate	148	0.217	0.384	−0.375	3.472
prize	195	9419.662	39265.740	0.000	297800.000
cpi	195	101.224	2.877	98.504	107.349
experiment	195	0.462	0.500	0.000	1.000
experiment_after	195	0.097	0.297	0.000	1.000
experiment_August	90	0.444	0.500	0.000	1.000
experiment_August_after	90	0.100	0.302	0.000	1.000

Table 7.4 Per capita growth rate of tax revenues in Huairou and in the other districts in Beijing before and after the experiments

District	*Time*	*Variable*	*Observation*	*Mean*	*Std. dev.*	*Min*	*Max*
Huairou	Before 2001	total_revenues_rate	2	0.231	0.067	0.183	0.278
		operation_tax_rate	2	0.068	0.224	−0.090	0.226
	2001	total_revenues_rate	1	0.470	??	0.470	0.470
		operation_tax_rate	1	0.769	??	0.769	0.769
Others	Before 2001	total_revenues_rate	34	0.273	0.311	−0.133	1.041
		operation_tax_rate	34	0.112	0.305	−0.343	1.027
	2001	total_revenues_rate	17	0.220	0.179	0.010	0.645
		operation_tax_rate	17	0.224	0.182	−0.004	0.658

Table 7.5 Per capita growth rate of tax revenues in the districts of Beijing (experiments from August and from October)

District	*Time*	*Variable*	*Observation*	*Mean*	*Std. dev.*	*Min*	*Max*
Experiments	Before	total_revenues_rate	21	0.336	0.332	−0.017	1.041
from	2002	operation_tax_rate	21	0.145	0.301	−0.312	1.027
August	2002	total_revenues_rate	7	0.241	0.369	−0.034	1.041
		operation_tax_rate	7	0.508	0.652	−0.079	1.592
Experiments	Before	total_revenues_rate	30	0.199	0.211	−0.133	0.661
from	2002	operation_tax_rate	30	0.152	0.258	−0.343	0.740
October	2002	total_revenues_rate	10	0.209	0.111	0.026	0.399
		operation_tax_rate	10	0.638	0.925	0.082	3.047

Table 7.6 Per capita growth rate of tax revenues in Beijing and Tianjin

District	*Time*	*Variable*	*Obs*	*Mean*	*Std. dev.*	*Min*	*Max*
Beijing	Before	total_revenues_rate	54	0.258	0.267	−0.133	1.041
	2002	operation_tax_rate	54	0.158	0.281	−0.343	1.027
	2002	total_revenues_rate	18	0.218	0.235	−0.034	1.041
		operation_tax_rate	18	0.550	0.793	−0.079	3.047
Tianjin	Before	total_revenues_rate	57	0.143	0.164	−0.353	0.716
	2002	operation_tax_rate	57	0.152	0.239	−0.375	1.133
	2002	total_revenues_rate	19	−0.014	0.072	−0.173	0.108
		operation_tax_rate	19	0.267	0.245	−0.277	0.657

Tianjin has issued receipts with lottery purchases only since January 1, 2004. Tianjin is adjacent to Beijing both geographically and culturally. They are both cities under the direct control of the

central government. According to Table 7.2, the populations, city scale, and income of these two cities are very similar. Therefore, I used Tianjin as a control area for a comparative analysis of before and after the experiments in Beijing. I obtained detailed information on the experiments, such as prize amounts and tax revenues, from the Tianjin Statistics Bureau, Tianjin Tax Bureau, Beijing Statistics Bureau, and Beijing Tax Bureau.[14] Therefore, I used the 5-year district-level data (18 districts in Beijing and 21 districts in Tianjin) to empirically examine the effect of the experiment.

Summary statistics of the data are reported in Table 7.3. The main information before and after the experiments is summarized by district in tables 7.4–7.6. These four tables provide some indication of the effects of the experiment.

7.3.2 *Specification for the Empirical Model and Method*

Following Heckman and Hotz (1989), Papke (1994), and Wooldridge (2002), I used the following empirical model (random growth model) to capture the effect of the experiments (equation (7.5)), and obtained

$$y_{it} = c_i + \beta \overline{LRE}_{it} + g_i t + u_{it}, \tag{7.6}$$

where y_{it} is the log value of per capita real operating tax revenue in district i and the information from the lottery receipt experiment ($\overline{LRE}_{it}$), g_i is the specific trend in the district, c_i is the specific time-invariant factor, and u_{it} is the white noise; they are all unobserved. The first difference of equation (7.6) becomes

$$\Delta y_{it} = \beta \Delta \overline{LRE}_{it} + g_i + \Delta u_{it}. \tag{7.7}$$

For a consistent estimator of β, the important condition is that the $\overline{LRE}_{it}$ is exogenous. As pointed out in Heckman and Hotz (1989) and Papke (1994), if there is a problem of self-selection regarding program participation, it is very hard to obtain a consistent estimator of β. As everyone knows, China is a centralized country, and policy changes cannot occur in a state or a city unless the central government grants permission; moreover, no state or city has the freedom to accept or reject central government policy.

Therefore, it can reasonably be said that $\overline{LRE}_{it}$ is exogenous. Moreover, because all of the samples used in the econometric analysis are areas that participated in the experiment, by using experiment information for different periods we can avoid the problem of self-selection and obtain a consistent estimator of the effect of the experiment.

Because the error term Δu_{it} is the one difference of u_{it}, it becomes a series correlation.[15] The fixed effect of panel estimation considering this characteristic of the error term is used to estimate equation (7.7). This method is explained in detail in Papke (1994) and Wooldridge (2002).

Variables Used in the Empirical Tests

Δy_{it} is the one difference of y_{it} which is the log value of per capita real operating tax revenue in district i and is the dependent variable. $\Delta\overline{LRE}_{it}$ is the dummy variable for an experiment district (1 for an experiment district, 0 for others) multiplied by the dummy variable for the experiment time (1 for experiment time, 0 for other time). $\Delta\overline{LRE}_{it}$ is the independent variable. $\Delta\overline{Prize}_{it}$ is the one difference of per capita real lottery prize; it is considered a proxy for capturing the experiment effect ($\Delta\overline{LRE}_{it}$) and is an independent variable.

7.4 Estimated Results

The estimated results are reported in Tables 7.7, 7.8, 7.9. The dependent variable is the logarithm of tax revenues, and the independent variable is the dummy; thus, the value of the estimated coefficient serves as the difference in the growth rates between the experiment and nonexperiment areas.

Table 7.7 is the result of panel estimation based on the information for 18 districts in Beijing. For total revenue, the effect of the experiment was not significant, although there was a 3.8% increase. In the case of operating (sales) tax, growth rates were significantly (23.5%) higher in the experiment areas than in the nonexperiment areas. The significance of the coefficient did not change with a policy dummy when using the prize as a proxy,

although it is hard to compare these two absolute values of the coefficient.

Table 7.8 shows the results of panel estimation based on the information for the 17 districts in Beijing. In eight districts, the experiment started in August 2002 and had lasted 5 months by December 2002, while in the other 10 districts, the experiment

Table 7.7 Estimated results based on the 18 districts in Beijing

	Δ *ln_Total revenues*		Δ *ln_Operation tax revenues*	
Δ LTE	0.038		0.235***	
	(0.039)		(0.076)	
Δ Prize		0.002		0.009***
		(0.002)		(0.003)
R^2	0.026	0.046	0.214	0.179
Observation	54	54	54	54

Note: Standard errors are in parentheses; ***significant at 1%.

Table 7.8 Estimated results based on the 17 districts in Beijing (experiments from August and from October)

	Δ *ln_Total revenues*	Δ *ln_Operation tax revenues*
Δ LTE	0.022	0.236*
	(0.064)	(0.132)
R^2	0.004	0.088
Observation	51	51

Note: Standard errors are in parentheses; *significant at 10%.

Table 7.9 Estimated results based on the 18 districts in Beijing and 21 districts in Tianjin

	Δ *ln_Total revenues*		Δ *ln_Operation tax revenues*	
Δ LTE	0.036		0.236***	
	(0.040)		(0.068)	
Δ Prize		0.002		0.009***
		(0.002)		(0.003)
R^2	0.011	0.019	0.141	0.116
Observation	111	111	111	111

Note: Standard errors are in parentheses; *** significant at 1%.

started in October 2002 and had lasted 3 months by December 2002. Because the experiment in Huairou started in January 2001, this district was removed from the sample. A comparative analysis of the 17 districts was performed. The results are very similar to those in Table 7.7. The effect of the experiment on total tax revenues was not significant, although there was a 2.2% increase. In the case of operating tax, there was about a 23.6% difference in the growth rates of the two groups of experiment areas. This result does not change with the tendency of the significance of the estimated coefficient in the case using the prize as proxy.

Table 7.9 shows the results of panel estimation based on the information for Tianjin and Beijing (18 districts in Beijing and 21 districts in Tianjin). The results in Table 7.8 are also very similar to those in Table 7.7.

7.5 Conclusion

This chapter examined, theoretically and empirically, the experiment of issuing a lottery receipt in China. When the revenue from the lottery is used to finance the public good, according to the proposal of Morgan (2000), even if a consumer has expected utility with quasilinear preference, he or she will purchase a lottery ticket. By issuing lottery receipts, the Chinese government can prevent tax evasion caused by collusion between firms and consumers and can collect operating (sales) taxes effectively to some extent. Our empirical examination of 5-year data from 39 districts in Beijing and Tianjin indicated that the real growth rate of operating (sales) tax was significantly (23.5%) higher in the experiment areas than in the nonexperiment areas. Moreover, because the datasets used were all from areas that participated in the experiments, and because the estimations were based on different periods of participation, self-selection problems were avoided. This analysis is similar to a kind of natural experiment.

The Chinese economy in the twentieth century was quite experimental; for example, there was the socialist economy experiment, the market economy experiment, and the experiment with lottery receipts. By means of these experiments, the Chinese

economy has both stagnated and grown. Although it is natural that some experiments will fail to an extent, it is obviously necessary to avoid failure if possible. Through the analysis of the datasets conducted in this study, the lottery receipt experiment can be judged as successful insofar as it increased operating (sales) tax revenues. Certainly, this new system of taxation will have a significant influence on future tax collection policies in China, and perhaps in other countries as well.

In future research, I must clarify theoretically and more specifically consumer preferences for lottery ticket purchases and empirically apply those data to the information from the experiment and nonexperiment areas after 2003. Moreover, I must obtain nationwide information and perform detailed analyses based on individual data, including attitudes toward the lottery receipt system. Additionally, because playing the lottery is a form of gambling, I must consider the social cost of gambling in relation to social welfare.[16]

8

Is the Life Cycle Model or Ono's Model Most Suitable for the Japanese? Analysis by Time-Series Data and Surveys of Lottery Purchase and Large Prizewinners

8.1 Introduction

The existence of persistent unemployment has been hotly debated by neoclassical and Keynesian economists. Neoclassical theory denies the existence of persistent unemployment, instead only acknowledging temporary unemployment as part of the business cycle. Keynesians, however, strongly insist on the existence of persistent unemployment, despite the fact that adequate microeconomic foundations have not yet been provided for it. In an attempt to compensate for this deficiency in the economic literature, Ono (2001) proposed a micro foundation for such unemployment using the standard money-in-utility-function (MIUF) model. The MIUF model has been empirically tested by many economists; for example, Poterba and Rotemberg (1987) and Holman (1998) found some evidence supporting the MIUF model. However, Ono (2001) has also been criticized because insatiability of liquidity or wealth (hereafter "the Ono hypothesis") is a necessary condition of the model. This assumption of insatiability has rarely been supported empirically, with one exception, namely Ono et al. (2004) (Ono et al. (1998) is the early version of this article). Ono et al. (2004) performed two estimations. The first was a parametric estimation employing time-series data, while the

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

second provided a nonparametric estimation using cross-sectional data on individuals. Ono et al. (2004) found that the hypothesis of the insatiability of money or wealth was supported in the case of Japan.

In this chapter, I use parametric and nonparametric methods and four unique datasets to clarify whether and what fraction of the Japanese population is insatiable with respect to money or wealth. In particular, I obtain striking results. Using annual Japanese data, I obtain evidence in support of the Ono hypothesis. In addition, using data from four microsurveys, I find that about 64.4% of Japanese participated in a lottery prior to 2003, and that about 51.5% of Japanese bought lottery tickets in 2003. In addition, 59.3% of lottery participants indicated that they bought tickets in the hope of winning the prize, despite the fact that the expected return to the lottery was negative. Individuals of an intermediate level of education were more likely to buy lottery tickets. Middle-income individuals were also more likely to participate, and this fact is consistent with the prediction of Friedman and Savage (1948). More than 46% of large prizewinners did not change their lifestyles, but 54% did make lifestyle changes after receiving a large prize (the magnitude of which was more than twice the average value of per Japanese household assets). On average, 60.85% of the largest prize (8.26 million yen) winners increased their consumption, and their behavior was thus consistent with the life cycle model. However, 39.15% (or 52.35%, if land and housing, work and business, and investments are considered as assets) of the largest prize winners did not increase their consumption; the behavior of these individuals thus strongly suggests that the life cycle model is inappropriate for the Japanese and instead providing support for the Ono hypothesis. Hence, if economic stimulation is to ease the current recession in Japan, consumption taxes or fiscal expenditure may be preferable to income or wealth tax cuts.

The remainder of the study is structured as follows. Section 8.2 introduces the theoretical framework. Section 8.3 presents the methodology and datasets. Section 8.4 reports the results, while Section 8.5 concludes and discusses policy implications.

8.2 Theoretical Framework

8.2.1 Model

A representative consumer is assumed to maximize his lifetime utility by choosing his levels of consumption and money holding.

$$\max_{c_\tau, m_\tau} V_t = E_t \sum_{\tau=t}^{\infty} \theta^{\tau-t} U\{c_\tau, m_\tau\}, \tag{8.1}$$

$$\overline{s.t.}\ A_\tau = (1 + R^B_{\tau-1})A_{\tau-1} + (1 + R^M_{\tau-1})M_{\tau-1} - P_\tau c_\tau - P_\tau m_\tau,$$

$$a_\tau = b_\tau + m_\tau.$$

E_t denotes the expectation operator conditional on information in period t. c_τ denotes real consumption. m_τ and A_τ, respectively, denote real money holdings and total nominal assets at the beginning of period τ. $R^B_{\tau-1}$ and $R^M_{\tau-1}$ are the nominal interest rates on bonds and money, respectively, at time $\tau - 1$. $\theta \in (0,1)$ is the discount factor, where $\theta = 1/(1 + \rho)$, and the additively time-separable constant ρ represents the time preference of the consumer. The consumer is further assumed to have full current-period information.

In this context, the Bellman equation is given by

$$V(a_t) = \max_{c_t, m} \{U(c_t, m_t) + E_t[\theta V(a_{t+1})]\},$$

$$\overline{s.t.}\ A_\tau = (1 + R^B_{\tau-1})A_{\tau-1} + (1 + R^M_{\tau-1})M_{\tau-1} - P_\tau c_\tau - P_\tau m_\tau,$$

$$\lim_{j \to \infty} \theta^j a_j = 0. \tag{8.2}$$

In addition, the solutions to the Bellman equation are given by

$$E_t\left[\theta \frac{\partial U_{t+1}/\partial c_{t+1}}{\partial U_t/\partial c_t} \frac{P_t}{P_{t+1}}(1 + R^B_t) - 1\right] = 0, \tag{8.3}$$

$$\frac{\partial U_t/\partial m_t}{\partial U_t/\partial c_t} - \left(\frac{R^B_t - R^M_t}{1 + R^B_t}\right) = 0. \tag{8.4}$$

8.2.2 Specification of Utility Function for Parametric Estimation

Following Wan (2001), it is assumed that the utility of consumption is additively separable from that of money. In

particular, $U(c_t, m_t) = u(c_t) + v(m_t)$, $u(c_t) = (1-\gamma)^{-1}(c_t^{1-\gamma} - 1)$, and $u(m_t) = \beta m_t + \alpha[(1-\eta)^{-1}(m_t^{1-\eta} - 1)]$. When these special utility functions are substituted into equations (8.3) and (8.4), I obtain

$$E_t\left[\theta\left(\frac{c_t}{c_{t+1}}\right)^{\gamma}\frac{P_t}{P_{t+1}}(1+R_t^B) - 1\right] = 0; \tag{8.5}$$

$$\left(\frac{R_t^B - R_t^M}{1+R_t^B}\right)\left(\frac{1}{c_t}\right)^{\gamma} - \alpha\left(\frac{1}{m_t}\right)^{\eta} - \beta = 0. \tag{8.6}$$

This system of two equations is estimated in the following section by means of annual Japanese data.

8.2.3 *Specification for Nonparametric Estimation*

Substituting equation (8.3) into equation (8.4), I get

$$E_t\left[\frac{\partial U_t/\partial m_t}{\partial U_{t+1}/\partial c_{t+1}}\frac{P_{t+1}}{P_t\theta(R_t^B - R_t^M)} - 1\right] = 0. \tag{8.7}$$

An expression for the marginal effect of money may be obtained by differentiating equation (8.7) with respect to m_t, as follows:[1]

$$E_t\left[\frac{\partial c_{t+1}}{\partial m_t}\right] = E_t\left[\frac{\partial u(c_{t+1})/\partial c_{t+1}}{\partial v(m_t)/\partial m_t}\frac{\partial^2 u(m_t)/\partial m_t^2}{\partial^2 u(c_{t+1})/\partial c_{t+1}^2}\right], \tag{8.8}$$

$$= 0, \overline{\textit{if and only if}}\ \partial^2 u(m_t)/\partial m_t^2 = 0,$$

$$\textit{that is}\ \partial u(m_t)/\partial m_t = \overline{\textit{constant}}, \tag{8.9}$$

$$> 0, \overline{\textit{if and only if}}\ \partial^2 u(m_t)/\partial m_t^2 < 0. \tag{8.10}$$

The intuition behind equations (8.8) – (8.10) is as follows. If a consumer increases his consumption upon experiencing a positive exogenous money or wealth shock, then his behavior supports equation (8.10) (consistent with the life cycle model); however, if instead he does not increase his consumption after the positive wealth shock, his behavior supports equation (8.9) (consistent with Ono's hypothesis).

8.3 Methodology and Data

8.3.1 Methodology

Following Hansen (1982) and Hansen and Singleton (1982), the System Generated Moment Method (GMM) is employed to estimate the parameters. A J-test is also used to test the overidentification restrictions. Mao (1990) pointed out that the estimator in this case is sensitive to the lags of instrumental variables (IV) and that, therefore, a lower IV lag is preferred. In this study, we follow this suggestion. In addition, GMM requires the stationarity of both the primary variables and the instruments, so I make use of unit root tests to ensure that all variables are stationary.

When using the individual data, I perform probit estimations and interval regressions to determine which individuals participated in the lottery. I also use graphs and tables to illustrate the behavior of the prizewinners.

8.3.2 Time-Series Data

Annual data for the period from 1965 to 1996 are likewise examined. In this case, R_t^B denotes the nominal return to stock investment, as determined by the Institute of Japanese Stock and Economic Research. Similarly, C_t denotes the final nominal household consumption expenditure, as taken from the Report on National Accounts of the Economic and Social Research Institute, Cabinet Office, Government of Japan. M_t denotes nominal household financial assets (i.e., cash, demand deposits, and postal savings), as taken from Flow of Funds Accounts, Bank of Japan. P_t is the GDP deflator, which is taken from the Report on National Accounts (Economic Planning Agency, Government of Japan, 1955-2003); N_t represents the total population of Japan and is obtained from the monthly report on the Japanese population. Finally, R_t^M is the interest rate on postal savings, which is taken from Monthly Economic Statistics. The variables c_t and m_t are processed according to C_t, M_t, and P_t.

8.3.3 Individual Data

I have four individual datasets deriving from lottery surveys. The first lottery survey, which was conducted by the Japanese Lottery Association, began in 1976 and was performed every 3 years thereafter. The tenth survey of this group took place in April 2004. The population surveyed comprised Japanese aged 18 and over. Of the 9,304 surveys that were randomly distributed, 6,557 were completed. A person was considered a lottery participant if he participated within the previous year, and a person was deemed an experienced buyer if he had experience as a lottery participant. Figure 8.1 illustrates both the participants and the experienced. Strikingly, the numbers of both have increased up to the present, in spite of the period of recession following the burst of the economic bubble. In 2003, the experienced numbered 71.5 million, or 68.4% of the Japanese population, while participants numbered 53.8 million, or 51.5% of the population. I also obtained information on total lottery ticket sales and the values of the largest prizes awarded by the Japanese Lottery Association. Figure 8.2 illustrates the data for these two groups of individuals for the period 1945-2003. It is evident that both classifications of lottery enthusiasts have continuously increased.

The second survey used is the Japanese Pachinko Survey, which was conducted by the Ace Research Institute. This survey was also random, and the survey population again comprised Japanese aged 18 and over. Not only were pachinko participation surveyed, but participation in other gambling activities, such as the lottery, were also surveyed, with a total of 2,575 respondents. The frequency of lottery ticket purchase is illustrated in Figure 8.3. The percentages of buyers and the experienced in this case were very similar to those in the case of the Survey on the Lottery performed by the Japanese Lottery Association. Thus, the Japanese Pachinko Survey and the Survey on the Lottery were sufficiently precise to capture lottery participation in Japan. The Japanese Pachinko Survey also surveyed buyer education and income, while these demographics were not collected in the Survey on the Lottery; thus, the two surveys can be used together for the purpose of testing various economic hypotheses. Individual data obtained from the 2001

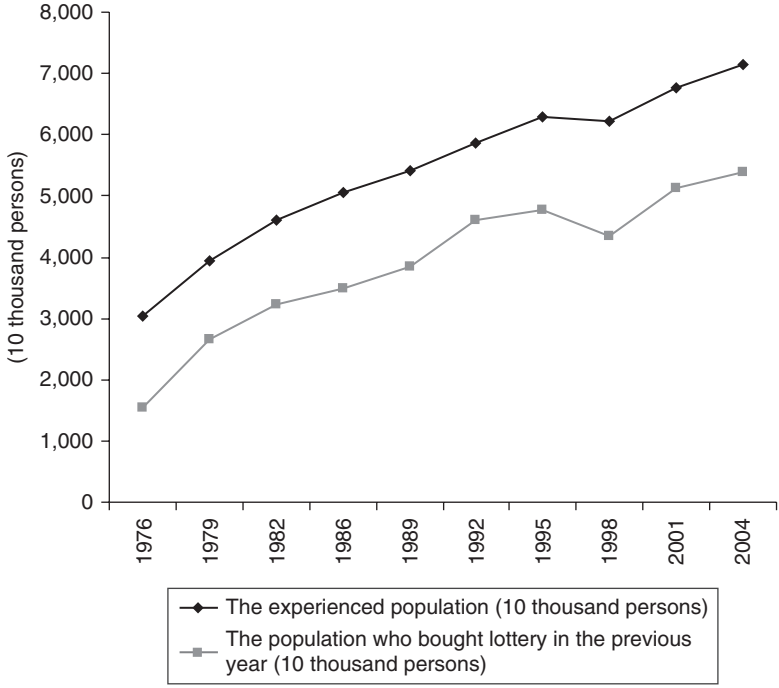


Figure 8.1 Lottery buying population and the experienced buyer: 1976–2004.

Japanese Pachinko Survey are thus used to clarify the effect of income and education on lottery ticket purchases.

The third survey used in this investigation is the 2003 Survey of Lottery Prize Winners, which was conducted by Mizuho Bank. Mizuho Bank is a corporate organization that deals with the sale of lottery tickets and the remuneration paid to winners. In 2003, 15,399 winners won prizes worth more that 1 million yen, and 3,188 of these winners won prizes worth more than 10 million yen. In recent years, Mizuho Bank has surveyed every large prizewinner during the collection of the prize. During the 2003 fiscal year, 6,001 respondents answered the relevant questionnaire.

The fourth survey examined comes from the 2003 White Paper on Large Prize Winners, which was likewise produced by Mizuho Bank. In this case, 1,495 respondents, whose prizes were worth more than 10 million yen, were surveyed. The 2003 Survey of

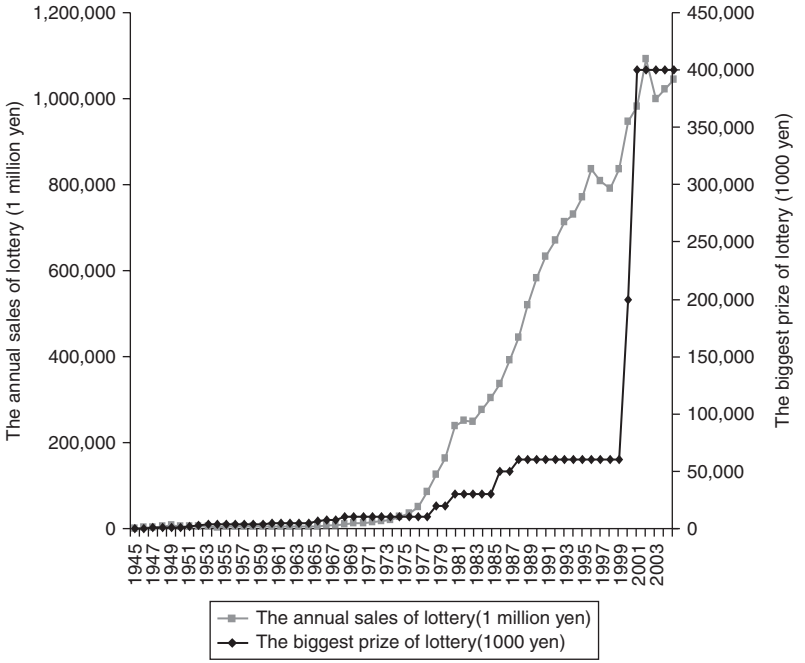


Figure 8.2 Annual lottery sales versus the biggest prize: 1945–2004.

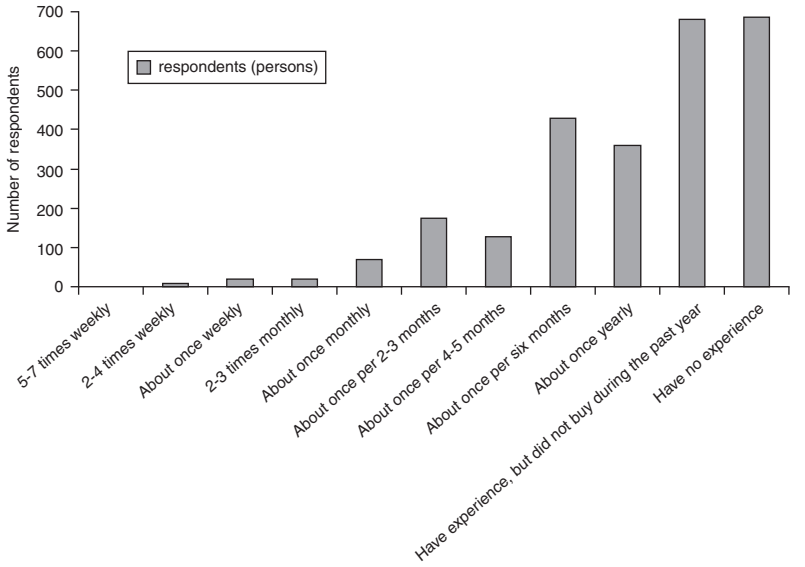


Figure 8.3 Frequency at which lottery was purchased in 2000.

Table 8.1 Estimation results for Ono's hypothesis (MIUF model)

	Coefficient	*p− value*
θ	0.998	0.000
α	0.337	0.000
γ	2.205	0.000
η	3.188	0.000
β	0.014	0.026

Note: GMM estimation; *J*-statistics=7.936; p -value = 0.54. Instrument variables: a constant, $(R^{B}_{t-1} - R^{rmM}_{t-1})/(1 + R^{B}_{t-1}), (1 + RBt - 1), (Pt - 1/Pt), (c_{t-1}/c_t), (1/c_{t-1}), (1/m_{t-2})$.
GMM, generalized methods of moments; MIUF, money-in-utility function.

Lottery Prize Winners and the 2003 White Paper on Large Prize Winners Survey were used to test the relevancy of the life cycle model and Ono hypothesis.

8.4 Results

8.4.1 Time-Series Data

The GMM estimation results are summarized in Table 8.1. θ, α, γ, and η are all significantly positive and take on reasonable values. The key parameter of interest, β, is also significantly positive. This evidence is consistent with the Ono hypothesis, which suggests that the Japanese consumer is insatiable with respect to money or wealth.[2]

8.4.2 Results from Individual Data

First, consider Table 8.2, which is derived from the 2004 Survey on the Lottery taken by the Japanese Lottery Association. This table illustrates the reasons why consumers choose to participate in the lottery. The most common responses, I wanted the lottery prize and I had a dream about the lottery, accounted for 59.3% and 50.6% of the respondents, respectively. According to a report by the Japanese Lottery Association in 2004, the price of one lottery ticket was determined in three parts: 39.8% of the price was a lottery tax, 14.2% of the lottery price was the cost of making

Table 8.2 Reasons for buying a lottory (4,453 respondents)

	Percent of respondents
I want a lottery prize	59.3
I have a dream of lottery	50.6
I enjoy it	32
It is an entertainment	30.5
I sometimes buy lottery just to keep company with a friend who buy it	8.3
Relief from stress	4.6
Because the profits are used for the public good	3
Because some interesting lotteries are on sale	1.4
Because I like the design of lottery	0.4
Because I am doing a collection of lottery	0.2
Others	1.3
I do not know; no special reason	3.2

Note: Multiple answers are allowed.
Source: Survey on Lottery 2004, Japanese Lottery Association.

and selling lottery tickets, and 46.0% of the lottery price was used to fund the lottery prize. Thus, when a buyer purchased a lottery ticket, he faced a negative expected return corresponding to 54% of his outlay. Furthermore, the fact that buyers nonetheless purchased tickets because they dreamed about the lottery or simply wanted the prize cannot be explained by standard economic theories, such as the expected utility framework with risk aversion. The behavior of Japanese consumers was thus either paradoxical or irrational.

Second, consider Table 8.3. This table presents three sets of estimation results clarifying the identity of the participants and the frequency of their participation in the lottery. The first column describes lottery participants by means of a probit (1 for experienced, 0 for unexperienced), while the second column provides similar results from an estimation incorporating also the level and square of weekly allowance. The coefficients of *high_school*, *tech_school*, and *university* are all significantly positive. The coefficient of *income*_600_800 is likewise significantly positive. These results imply that

Table 8.3 People who buy lottery and the frequency at which they buy it (dependent variable = the number of times of purchasing lottery)

	Lottery	*Lottery*	*Lottery_times*
male	0.317	0.314	1.784
	(3.97)***	(3.92)***	(2.78)***
age10s	−0.631	−0.613	−3.895
	(4.35)***	(4.20)***	(2.43)**
age30s	0.221	0.222	0.255
	(1.95)*	(1.96)*	(0.26)
age40s	0.095	0.093	0.468
	(0.82)	(0.80)	(0.46)
age50s	0.013	0.001	−0.343
	(0.11)	(0.01)	(0.33)
age60s	−0.156	−0.175	−2.132
	(1.38)	(1.53)	(1.78)*
single	−0.368	−0.413	−2.702
	(3.32)***	(3.54)***	(2.76)***
part_arubait	−0.056	−0.053	−0.758
	(0.53)	(0.50)	(0.91)
student	−0.548	−0.530	−3.711
	(3.58)***	(3.44)***	(2.49)**
housewife	0.063	0.075	−0.699
	(0.61)	(0.71)	(0.89)
high_school	0.213	0.210	−1.470
	(2.15)**	(2.11)**	(1.14)
tech_school	0.323	0.317	−1.577
	(2.49)**	(2.44)**	(1.16)
college	0.107	0.097	−2.406
	(0.84)	(0.75)	(1.75)*
university	0.211	0.200	−1.924
	(1.77)*	(1.67)*	(1.39)
income_200400	0.014	0.001	−0.451
	(0.14)	(0.01)	(0.68)
income_400600	0.142	0.119	0.381
	(1.21)	(1.01)	(0.40)
income_600800	0.273	0.249	−0.001
	(1.95)*	(1.75)*	(0.00)
income_8001000	0.121	0.083	−0.274
	(0.74)	(0.50)	(0.27)
income_10001500	0.313	0.260	−0.269
	(1.35)	(1.09)	(0.21)
income_over1500	−0.079	−0.121	−3.432
	(0.21)	(0.29)	(2.72)***
weekly_allowance		0.008	0.078
		(1.21)	(2.03)**
weekly_allowance_square	−0.000	−0.001	
		(0.85)	(1.29)

continued

Table 8.3 Continued

	Lottery	*Lottery*	*Lottery_times*
Constant	0.412	0.383	2.105
	(2.69)***	(2.46)**	(1.24)
Log likelihood	−1302.637	−1301.862	−7321.731
Observations	2575	2575	2575

Note: Robust *z*statistics in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Estimation method for columns 1 and 2: probit estimation.
Estimation method for column 3: interval regression.

middle_income individuals were more likely to have experience of lottery participation. The third column presents results from an interval regression (the dependent variable derives from interval data in this case) clarifying the frequency of lottery participation. In terms of the frequency of purchase, those respondents having at least a college education were less likely to participate than those with less than a high-school education. Moreover, the coefficient of the highest income variable, *income_over*1500, is negatively significant. Other proxies used in place of buyer income include the level and square of *weekly_allowance*. The coefficient of *weekly_allowance* is positive and significant, but the coefficient of the square of weekly allowance is not significant. This evidence is consistent with the prediction of Friedman and Savage (1948).[3]

Third, consider Table 8.4. This table presents information regarding who the recipients of large prizes (worth over 1 million yen) chose to inform of their winnings, based on the 2003 Survey of Large-Prize Winners conducted by Mizuho Bank. In general, the winner most often chose to share this information with his spouse. However, 24.7% of winners kept the information to themselves, perhaps for fear of losing part of the benefit upon announcing the prize.

Fourth, Table 8.5 indicates the identity of large prizewinners. The first column in this table indicates that 6,001 respondents each received prizes worth at least 1 million yen, while the second column indicates that 1,495 respondents received prizes worth at

Table 8.4 Announcing a big win: Who does the winner tell of winning a big prize? (6,001 respondents whose prizes are over 1 million yen)

	Percentage
Wife or husband	42.1
Parents	12.1
Children	12.2
Brothers or sisters	4.9
Grandmothers or grandfathers	0.8
Grandbaby	0.1
Friends	7.8
Working mate	4.9
Lovers	2.8
Relatives	1.2
Others	1.1
Nobody is told	24.7
No answer	7.9

Note: Multiple answers are allowed.
Source: Survey on the Big Prize Winner 2003, Mizuho Bank.

least 10 million yen, in 2003. The demographics of these samples are summarized by sex, age, and career. No large differences are apparent between the two columns.

Fifth, Table 8.6 presents winner lifestyle changes resulting from the prize. The first column provides the responses of the full sample (6,001 respondents). The remaining columns provide answers for recipients of 1–3 million yen prizes, through to recipients of 100–400 million yen prizes. Note that 60.7% of respondents in the full sample did not make any lifestyle changes. This is a striking result. Even in the eighth column, in which the average prize was about six times the net average for Japanese household assets in 1999 (see Ogawa and Wan 2004, 2007), 46% of the winners made no changes in their lifestyles. This observation cannot be explained well by the life cycle model, though it is consistent with the Ono hypothesis. The behavior of respondents who did increase their degree of family service, enriched their leisure time, increased their filial devotion to their parents, increased their acquaintances, got married, or altered their job or retirement status is well explained

Table 8.5 The big prize winner?

		Percentage (6,001 respondents who got over 1 million yen prize in 2003)	*Percentage (1,495 respondents who got over 10 million yen prize in 2003)*
Full sample	Male	77.4	67.8
	Female	22.6	32.2
	Total	100	100
Male sample	Under age 29	6.7	7.1
	Age 30–39	18.7	16.6
	Age 40–49	20.9	19.1
	Age 50–59	27.6	26.6
	Age 60 and over	26.1	30.7
	Total	100	100
Female sample	Under age 29	6.9	9.8
	Age 30-39	17.1	14.7
	Age 40-49	20.7	17.4
	Age 50-59	34.4	27.6
	Age 60 and over	21	30.5
	Total	100	100
Career	Salaried worker in company	43.8	40.8
	Public cleck	3.6	4.7
	Self-employee	17.2	13.7
	Free employee	2.8	1.5
	Student	0.7	0.4
	Agricultural	0.8	1.4
	House wife	11.4	14.2
	Others	5.6	6.7
	No job	14	16.5
	Total	100	100
Experience of buying lottery	First time		1.7
	Less than one year		3.9
	1-5 years		12.8
	5-10 years		16.5
	Over 10 years		56.9
	No answer		8.2
	Total		100

Source: Column 1 is from the Survey on Prize Winner 2003, Mizuho Bank.
Column 2 is from the White Paper on the Big Prize Winner 2003, Mizuho Bank.
Column 1: For the winners (6,001 respondents who got over 1million yen prize in 2003).
Column 2: For the winners (1,495 respondents who got over 10 million yen prize in 2003).

by the life cycle model. In particular, increases in family service, filial devotion to parents, and getting married appear to have been normal goods, while acquaintances may have been inferior.

Table 8.6 Life style changes after winning a prize (percentage)

	1	2	3	4	5	6	7	8
Increase in family service	13.5	12	14.8	15.6	15	15.8	14.3	28.6
Enrichment of leisure	9.3	7.9	9	8.5	12.9	11.4	23.2	17.5
Filial devotion to parents	7.6	4.7	8	11.1	11.1	19.3	14.3	22.2
Increase in acquaintance	2.2	2.6	2.8	2.2	1.2			
Increase in social contribution	1.3	1.2	0.6	1	1.7	3.5	1.8	3.2
Get married	0.9	0.6	0.6	1	1.7		7.1	
Job change or retirement	0.8	0.6	1.9	1	0.7	0.9	1.8	3.2
Other	3.5	3.7	1.5	3.9	3.3	4.4	1.8	3.2
No any change	60.7	62.1	66	60	57.3	57.9	44.6	46
No answer	8.8	10.1	5.6	6.8	8	7	10.7	3.2

Note: Multiple answers are allowed.
Column 1: For 6,001 winners (full sample, over 1 million yen prize, average prize is 8.26 million yen).
Column 2: For 3,462 winners (1-3 million yen prize, average prize is 2 million yen).
Column 3: For 324 winners (3-5 million yen prize, average prize is 4 million yen).
Column 4: For 926 winners (5-10 million yen prize, average prize is 7.5 million yen).
Column 5: For 1,056 winners (10-30 million yen prize, average prize is 20 million yen).
Column 6: For 114 winners (30-50 million yen prize, average prize is 40 million yen).
Column 7: For 56 winners (50-100 million yen prize, average prize is 75 million yen).
Column 8: For 63 winners (100-400 million yen prize, average prize is 250 million yen).
Source: Survey on the Lottery Prize Winner 2003, Mizuho Bank.

Sixth, Table 8.7 provides information on how the prizewinnings were to be used. The first column provides the answers of 6,001 respondents, while the third column presents those for the 1,495 respondents with higher winnings. The average prize received by respondents in the first column was 8.26 million yen, while the corresponding figure in the eighth column was 23.18 million yen. Thus, the results in Table 8.7 provide a direct measure of the impact of the income on expenditure and saving (equations 8.9 and 8.10). The saving rate of respondents increased remarkably (by about a factor of two) when the prize amount rose from 8.26 million yen to 23.18 million yen. The purchase of land and housing rose from 5.4% to 28.4%, and this increase implies that land and housing were considered normal goods (furthermore, as land and housing are two different types of assets, the imputed rent corresponds to consumption). Education and culture, cars,

Table 8.7 Spending the prize money (percentage)

	For 6,001 winners (over 1 million yen prize, average prize is 8.26 million yen		*For 1,495 winners (over 10 million yen prize, average prize is 23.18 million*	
	Not adjusted	*Adjusted by dividing 1.354*	*Not adjusted*	*Adjusted by dividing 1.772*
Saving	24.4	18.0	41.9	23.6
Repayment of loans	24.2	17.9	28.8	16.3
Hobby, leisure	17.2	12.7	9	5.1
Travel	14.1	10.4	13.2	7.4
Purchase of car	7.1	5.2	13.8	7.8
Foods	6.3	4.7	4.3	2.4
Clothing, accessories	5.5	4.1	5.4	3.0
Land, housing	5.4	4.0	28.4	16.0
Education, culture	5.3	3.9	7	4.0
Work, business	5.2	3.8	5.4	3.0
Investment	2.6	1.9	2.9	1.6
Beautification, health	0.8	0.6	1.1	0.6
Donation, social contribution	0.8	0.6	1.3	0.7
Others	10.3	7.6	10.8	6.1
No answer	6.2	4.6	3.9	2.2

Note: Multiple answers are allowed.
Because the sum of column 1 is 135.4, column 2 is adjusted by dividing column 1 by 1.354.
Because the sum of column 3 is 177.2, column 4 is adjusted by dividing column 3 by 1.772.
Source: Columns 1 and 2 are from the Survey on the Lottery Prize Winner 2003, Mizuho Bank.
Columns 3 and 4 are from the White Paper on the Big Prize Winner 2003, Mizuho Bank.

beauty and health, and donations and social contributions were also considered normal goods. However, preferences with regard to food, clothing, accessories, and travel were not immediately clear, though these may have been considered inferior goods. A summation of the information in the first column, excluding savings and loan repayments, yields an estimate of 86.8%, which means that over 13.2% of respondents did not increase their consumption, even when receiving an 8.26-million-yen prize. This observation suggests that the life cycle model may not be appropriate in this case and rather provides support for the Ono hypothesis. In addition, as indicated by the first column in Table 8.7, if the respondents who chose to save were different from those who chose to repay loans, but if they likewise chose not to increase their consumption, then a maximum of 65.1% of Japanese (if prize was assumed to be randomly distributed among lottery buyers, 51.5% of Japanese population was lottery buyers in 2003, $65.1\% \times 51.5\% = 33.5\%$) could be inferred as behaving in a manner consistent with the Ono hypothesis. Thus, 20.2% ($13.2 \times 51.5\% = 6.8\%$ at a minimum, $65.1\% \times 51.5\% = 33.5\%$ at a maximum) of Japanese on average did not behave in accordance with the life cycle hypothesis; rather, their behavior was consistent with the Ono hypothesis. Alternatively, if land and housing, work and business, and investments are also considered as assets, then the confidence interval ranges from 13.6% ($26.4\% \times 51.5\% = 13.6\%$) to 33.7% ($65.4\% \times 51.5\% = 33.7\%$). On average, the behavior of 27.0% ($52.4\% \times 51.5\% = 27.0\%$) of respondents undermines the life cycle hypothesis but supports the Ono hypothesis. Certainly, even if some fraction of respondents chose to increase their consumption, but if the size of consumption increase was sufficiently small, then the behavior of these people would also be consistent with the Ono hypothesis.

8.5 Conclusion and Policy Implications

8.5.1 Findings

Using the GMM and Japanese time-series data, I tested the MIUF model and the Ono hypothesis. The resulting evidence supports not

only the MIUF model, but also the Ono hypothesis, which suggests that the Japanese consumer is insatiable with respect to money or wealth.

In the course of this analysis, I used two national surveys taken from two different organizations to clarify the characteristics and participation frequency of lottery participants. Participants indicating that they purchased lottery tickets because they "wanted the lottery prize" or "had a dream about the lottery", respectively. When a buyer purchased a lottery ticket, he faced a negative expected return equivalent in magnitude to 54% of his financial outlay. Thus, participation in the lottery cannot be explained by standard economic theory, such as the expected utility framework with risk-averse agents. Respondents with higher education were more likely to have experience of lottery participation. Similarly, respondents with middle income were also more likely to have experience of lottery participation. This income effect on lottery purchase is consistent with the prediction of Friedman and Savage (1948).

I also made use of two surveys of prizewinners to clarify their behavior after they received large prizes and test whether the life cycle model or the Ono hypothesis was best supported. The winner's spouse was usually informed of the prize receipt, but 24.7% of winners did not tell anyone that they had won. The behavior of respondents who did increase their family service, enriched their leisure time, increased their filial devotion to their parents, increased their number of acquaintances, got married, or altered their job or retirement status is well explained by the life cycle model. In addition, family service, filial devotion to parents, and getting married were considered normal goods, while acquaintances seem to have been considered inferior goods. Forty-six percent of winners did not make any lifestyle changes. This observation cannot be well explained by the life cycle model but is consistent with the prediction of Ono hypothesis.

Land and housing were considered normal goods. In addition, education and culture, cars, beauty and health, and donations and social contributions were all considered normal goods. However, food, clothing, accessories, and travel appear to have

been considered as inferior goods. Over 13.2% of respondents did not increase their consumption, even after receiving an 8.26-million-yen prize. This behavior of over 13.2% (39.15 % on average) of respondents undermines the life cycle hypothesis and instead provides strong support for the Ono hypothesis.[4] If land and housing, work and business, and investments are considered as assets, then on average the consumption behavior of 52.35% of respondents rejects the life cycle model but supports the Ono hypothesis.

8.5.2 Policy Implications and Remaining Issues

Because big fraction of Japanese are insatiable for money or wealth and do not behave in the manner predicted by the life cycle model, the range of policies with potential for effective economic stimulation is limited. In other words, the effects of income and wealth tax cuts are likely to be limited or very weak, while a consumption tax or increased fiscal expenditure should be more effective.[5]

Several issues are left for future research. In the context of the time-series analysis conducted, I should extend the time series and use quarterly and monthly data in the course of estimation, as these data are readily obtainable. In addition, some specification error may be present in the equations estimated, and so I should investigate other functional forms for the utility function. In the context of the individual analysis, I should investigate the fraction of prizewinners who did not increase their consumption, as well as obtain detailed explanations of this behavior. For example, I could directly interrogate the winners and ask them why they did not alter their consumption behavior even after winning a large lottery prize. The participant's age and asset and debt holdings are also key variables in the context of the life cycle model and should be controlled for. These latter omissions are likewise left for future investigation.

9

Conclusions

9.1 Findings, Problems Solved, and Policy Proposals

Numerous findings are reported in Chapters 2–8. I outline them here, briefly, by chapter.

In Chapter 2, an RA model with an optimal inventory was developed; this model can be used as a new way to distinguish consumption from purchases at a time when there is perfect foresight concerning price. The theoretical framework was tested using daily and monthly cigarette purchases in Japan. The RA model was not supported when inventory was not considered, as the inventory became an omitted variable and correlated with price, while it was supported if the optimal inventory was included in the estimating equation. As the tax elasticity of hoarding exceeds 400%, a tax increase is considered a good tool for temporary economic stimulation.

Chapter 3 clarified the effects of health information on cigarette consumption and intake of nicotine and tar in the RA framework. The consumer overconsumes cigarettes because of a shortage of health information and reduces consumption when new health information is announced. Auld and Grootendorst (2004) have pointed out that the estimable RA model tends to yield spurious evidence when aggregate data are used; if, however, prices are exogenous, instrumental variable estimates will be consistent. The Japanese cigarette price is considered exogenous because it is determined by the government. The RA model with health information is supported by Japanese monthly data and policy

J. Wan, *Consumer Casualties*
© Junmin Wan 2014

events. Robust evidence has also been obtained from Japanese national surveys. The consumer responds to new information by changing cigarette type, or by reducing or quitting smoking. The total intake of nicotine and tar is significantly decreased by the release of nicotine and tar content information. Tobacco control policies, such as cigarette taxes and health information, were shown to be effective, but the effect of health information was bigger than that of a tax increase.

Chapter 4 introduced a new way to examine the effects of mandatory information disclosure on interbrand cigarette demands and the behavior of a monopolistic firm in Japan. I estimated interbrand demands by including nicotine, tar content, and policy event information in the model and by using cigarette brand sales data. I found that the mandatory disclosure of nicotine and tar content information decreased the intake of nicotine and tar per capita and per smoker; thus, mandatory disclosure is likely to increase consumers' welfare, if I suppose that they always choose their favorite cigarette. Furthermore, I also found that the monopolistic firm supplied a greater number of new and better quality products and that it discontinued the production of poorer quality goods and conducted more R&D, in response to disclosure mandates.

In Chapter 5, the following findings were presented. The market volume of the pachinko industry exceeds 28 trillion yen, and its added value is about 0.86% of GDP in 1999. According to the Survey of Pachinko Addiction and Survey of Pachinko and the Pachinko-slot Players, pachinko gives rise to two social problems: pachinko addiction (29.3% of pachinko addicts think they need medical treatment) and an increased probability of household bankruptcy. Based on the estimation results using individual data from the Japanese Pachinko Survey, 2003, the addiction hypothesis, based on pachinko as gambling, was strongly supported. The pachinko player's experience involved a significant decrease in the desire to stop participation in the future, an increase in the desire to commence reinitiation after quitting, and a decrease in the duration of nonplaying after quitting. Thus, regulation

policies for pachinko are necessary. The evidence obtained in this study may also be very helpful in a reconsideration of the assumption of risk-averse behavior and in understanding the economic phenomenon of the bubble, etc.

In Chapter 6, I used a unique individual dataset to clarify the relation between pachinko gambling and smoking. I showed that they are positively correlated, and I also showed their causality. Pachinko gambling increases smoking; thus, smoking is complementary to gambling. However, the desire to play pachinko in premises where a smoking ban is operative decreases, owing to the status of smoking in these premises; thus, pachinko is also complementary to smoking. Because smoking is harmful to health and gambling causes household bankruptcy in Japan (strong negative externalities), some regulation policies (smoking ban, etc.) are needed. Because of their complementarity, the effect of regulation is expected to be greater than usual.

In Chapter 7, I researched a new system of taxation called lottery receipts, which has been operating in China, theoretically and empirically. The budget deficit, mitigation of inequality, etc., and income redistribution have meant that the supply of public goods by an efficient and fair tax collection system has become necessary in China. However, as it is difficult for the government to monitor actual economic dealings because of information asymmetry, tax collection is not easy. Therefore, in order to bring out private information, known only to a seller and a buyer, the Chinese government has set up a lottery receipt system, which has been tested in a number of areas. This study considers the validity of this system, both theoretically and empirically. When the net revenue from a lottery is invested in pure public goods, Morgan (2000) has shown that public lotteries have been purchased, even if the consumer expected utility with quasilinear preferences. By this means, the Chinese government hopes to prevent tax evasion caused by conspiracies between firms and consumers, and to collect tax effectively, to some extent, by issuing a receipt with a fixed-prize lottery ticket. In the empirical analysis, estimation that avoided self-selection was performed based on panel data for

different periods from a total of 39 districts in Beijing and Tianjin, since 1998, when the experiment started. This study finds that the lottery receipt system has significantly increased the real growth of operating (sales) tax.

In Chapter 8, the linkage between the traditional life cycle model and Ono hypothesis model was analyzed; subsequently, they were theoretically and empirically tested using time-series data and surveys on lottery buyers and prizewinners. Using GMM and Japanese annual data, evidence was obtained that supports Ono's hypothesis, which implies that the Japanese consumer is characterized by an insatiable desire for money and wealth. In addition, four surveys were used to clarify who buys lottery tickets, and why, and to determine what the winners do after obtaining their prize. The reasons why individuals buy lottery tickets have been identified as, "I want the lottery prize," and "I had a dream about the lottery," according to 59.3% and 50.6% of respondents, respectively. Those in the middle-income bracket are more likely to have had experience of lottery ticket purchase. Usually, a wife or a husband will receive news of a big win, but 24.7 % of winners tell nobody. Forty-six percent of winners do not change their lifestyle after winning the lottery. On average, 39.15% (if land and housing, work and business, and investment are considered assets, averaging 52.35%) of respondents do not increase their consumption, even if they are awarded the 8.26 million yen prize. This kind of behavior on the part of Japanese lottery winners strongly rejects the life cycle hypothesis, but supports Ono's hypothesis, while the behaviors of 60.85% of Japanese lottery prizewinners support the life cycle model. Thus, the effects of an income tax cut and a wealth tax cut on economic stimulation are limited or weak; a consumption tax and fiscal expenditure are expected to be more effective. An increase in family service, filial devotion to parents, and getting married are superior goods; land and housing, education and culture, the purchase of car, beautification and health, leisure time, job change or retirement status, and donations and social contributions are also considered as superior goods. Food, clothing, and accessories, travel are unclear categories, but seem to be inferior goods.

9.2 Issues Remaining for Future Research

In Chapter 2, consumers' response to health information was not analyzed. In Chapter 3, the welfare change arising from increased price and health information was not analyzed in detail. In Chapter 4, there were two major issues that have not been addressed in this study. The first is that the addictive nature of smoking was not considered in the estimated model. It would be interesting to introduce the effect of information disclosure into the frameworks of Becker et al. (1994) or Wan (2004a). The second issue is that the approach of Yen and Chern (1992) should be used to estimate information effects.

In Chapter 5, the player's "rationality" was not tested. To test this, some tax or price shocks are needed. In Chapter 6, the stability of the preference of the gambler and simultaneous smoker was not tested, and the addictiveness of the two goods has not been tested simultaneously. In Chapter 7, consumers' preference with regard to lottery ticket purchases, on an individual basis, should be theoretically clarified to a finer degree; this should be empirically tested too, using information on the experimental and nonexperimental areas from 2003, as well as nationwide information. Detailed analysis based on individual data that include consumers' attitudes to the lottery receipt system, etc. should be performed as shown in Wan (2009c). Moreover, as purchasing lottery tickets is a form of gambling, it is necessary to take the social cost of gambling into consideration in discussions of social welfare in this context.

In Chapter 8, some issues for future research were noted. With respect to the time-series analysis, we should extend the time series and use quarterly and monthly data, given that they are easily obtained. Additionally, there may be some specification errors in the equations; therefore, we have to try other forms of the utility function. In the individual analysis, we need to know the number of prizewinners who did not increase their consumption, and the reasons for this in detail. One way to approach this is to ask direct questions concerning their reasons for not changing their consumption patterns after receiving a large lottery win. Age, asset holdings, and debt levels, etc., are also key variables that should

be used to test the life cycle model and should be controlled. These matters are left for future studies.

Finally, it is expected that some more explanations and causalities will be researched and presented in the future. Moreover, to protect consumer from various casualties, not only wisely but also benevolently governmental interventions as public goods are indispensable. Hence, it would be also very important for the general public to build a benevolent government, which is organized by self-interested individuals, in line with Olson (1965, 1982, 2000)'s works.

Notes

1 Introduction

1. See Ono (2001) for details.
2. This is described in Chapter 6.
3. This point is related to Chapters 4 and 5.
4. There have been some interesting studies using this approach, from the beginning of 1990s. See Angrist and Krueger (1991), Meyer et al. (1995), and Resenzweig and Wolpin (2000) for details.

2 Rational Addiction with an Optimal Inventory: Theory and Evidence from Japanese Daily and Monthly Purchases

1. There appears to be a misprint in Becker et al. (1994). According to my calculations, the last multiplicative term in the numerator of the formula for θ_3 should be $u_{2y}u_{ey}$ instead of $u_{2y}u_{2e}$.
2. See Becker et al. (1994) for details.
3. The elasticity is higher than that in Wan (2002c,2006) because the health information effect is not considered here.
4. This policy has been proposed by Charles Yuji Horioka at Osaka University since January 18, 2002; see, e.g., Horioka (2002a, 2002b).
5. It is also analyzed in detail in Wan (2002c).

3 Response to Health Information: Theory and Evidence from Cigarette Consumption and Intake of Nicotine and Tar in Japan

1. See Wan (2004d) for details.
2. In the $\alpha(0) = 0$ case, the model is the same as Becker et al.'s (1994).

3. There seems to be a misprint in Becker et al. (1994). According to my calculations, the last multiplicative term in the numerator of the formula for θ_3 should be $u_{2y}u_{ey}$ instead of $u_{2y}u_{2e}$. $\theta_0 = -\lambda(u_{y1} + \beta u_{y2})$, $\theta = \frac{-(u_{12}u_{yy}-u_{1y}u_{2y})}{(u_{11}u_{yy}-u_{1y}^2)+\beta(u_{22}u_{yy}-u_{2y}^2)}$, $\theta_1=\frac{u_{yy}\lambda}{(u_{11}u_{yy}-u_{1y}^2)+\beta(u_{22}u_{yy}-u_{2y}^2)}$, $\theta_2=\frac{-(u_{yy}u_{1e}-u_{1y}u_{ey})}{(u_{11}u_{yy}-u_{1y}^2)+\beta(u_{22}u_{yy}-u_{2y}^2)}$, $\theta_3=\frac{-\beta(u_{yy}u_{2e}-u_{2y}u_{ey})}{(u_{11}u_{yy}-u_{1y}^2)+\beta(u_{22}u_{yy}-u_{2y}^2)}$. A good is addictive if $\theta > 0$, and the degree of addiction increases with θ. The roots of the difference equation are $\phi_1 = \frac{1-(1-4\theta^2\beta)^{1/2}}{2\theta}$, $\phi_2 = \frac{1+(1-4\theta^2\beta)^{1/2}}{2\theta}$, and the stability conditions are $4\theta^2\beta < 1$, $\phi_1 < 1$, $\phi_2 > 1$. The short- and long-run price effects are $\frac{dC_t}{dP^*} = \frac{\theta_1}{\theta(1-\phi_1)\phi_2}$, $\frac{dC_\infty}{dP} = \frac{\theta_1}{\theta(1-\phi_1)(\phi_2-1)}$. See Becker et al. (1994) for details.
4. The results in this chapter are different from Haden (1990). The price and income elasticities of Japanese cigarette consumption are estimated by Haden (1990) using annual data for 1964–1983. Haden estimates the income elasticity to be 0.161 and the price elasticity to be −0.948. Thus, cigarette is a normal good. The results in this chapter are also different from those of Yorozu and Zhou (2002). They estimate the income and price elasticities of demand for cigarettes to be 0.291 and −0.986, respectively. According to Gruber and Köszegi (2001), the long-run price elasticity in the United States (based on monthly data) is −0.8, while we estimate the long-run price elasticity in Japan to be −0.524. Thus, the absolute value of the long-run price elasticity is somewhat smaller in Japan than in the United States. Also see other studies such as Chaloupka (1991), and Chaloupka and Warner (1999, 2000) for detail of the price elasticity in the United States.
5. The long-run elasticity is about −0.67, see Wan (2004b).
6. A Chow test is performed, and the structural change is confirmed.
7. A Chow test is also performed and the structural change is confirmed.
8. See Appendix 3B for details.
9. The wording of the questions about the information on damage from smoking is very similar even though these two surveys were conducted by two different institutions and in different time.
10. Reasons why former smokers quit or reduced smoking are not shown here. The reasons are very similar to why smokers want to quit.

4 Responses of Consumers to Mandatory Disclosure of Information: Evidence from Japanese Interbrand Cigarette Sales

1. See details in Dranove et al. (2003).

2. An analysis of the aggregate demand for cigarettes in Japan as a response to health information is presented in Wan (2004d).
3. Asahi Shimbun and Mainichi Shimbun are the main newspapers in Japan.
4. Calculation details are presented in Wan (2004a).
5. Data from 1985 is not available because JT has not been disclosing the interbrand cigarette sales since privatization in 1985.

5 Is Gambling Addictive? Evidence from Pachinko Participation, Quitting, and Reinitiation

1. The game is currently divided into two types: one is called "pachinko," which is a mechanical gambling game, and the other is called "pachinko slot," or "pachisuro," which is a digital (i.e., computer style) gambling game that appeared recently, owing to the development of computer technology. The opportunity to gamble constitutes the common feature of the two games, although they differ with respect to the gambling times and the techniques involved.
2. This survey (in Japanese, Sabisugyou Kihon Chousa), which is performed by the Ministry of Public Management and the Ministry of Economy, Trade, and Industry in Japan was started in 1989 and has been revised every 5 years. It has been continued to date.
3. This survey was performed by the Japan Gaming Labor Union Association in November 2003. Pachinko parlor managers were randomly surveyed, and 4,645 effective answer sheets were obtained in Japan (the response rate was 98.8%).
4. This survey was performed by the Japan Gaming Labor Union Association in December 2003. Pachinko players (including pachinko slot players) were randomly surveyed, and 4,493 effective answer sheets were obtained in Japan (the response rate was 99.7%).
5. Nevertheless, gambling is prohibited (Article 185 of the Japanese criminal code).
6. See Starmer (2000) for details.
7. These data are available in the Social Science Japan Data Archive, Institute of Social Science, University of Tokyo. Anybody can access them with an application.
8. Strictly speaking, there are two surveys. The survey population of the first survey is Japanese ages 18 and over, while the population of the second survey is those who have quit playing pachinko (including pachinko slot) for more than 1 year before the survey date.
9. Data of duration are all right censored because the duration of non reinitiation was still continuing at the survey date. Thus, there is measurement error in the dependent variable (duration). This (exogenous) measurement error will not bias the estimated coefficient but will

overestimate the standard error of coefficient when using OLS. Because the mean of the measurement error is just equal to the mean of observed duration, the estimated elasticity is overestimated by a factor of 2. Thus, to obtain the real elasticity, suitable adjustment is necessary. The estimated elasticity should be multiplied by 0.5 to return to the real elasticity.

10. The elasticities of yearly-past-times are −0.107 (outcome (1)), 0.086 (outcome (2)), 0.246 (outcome (3)), and 0.462 (outcome (4)), respectively; the elasticities of yearly-past-manyen are −0.049 (outcome (1)), 0.040 (outcome (2)), 0.112 (outcome (3)), and 0.208 (outcome (4)), respectively; the elasticities of yearly-past-hours are −0.048 (outcome (1)), 0.038 (outcome (2)), 0.108 (outcome (3)), and 0.203 (outcome (4)), respectively.
11. I have made the adjustment noted in footnote 35. The estimated elasticity has been multiplied by 0.5.

6 Are Gambling and Smoking Complementary? Direct Tests from Japanese Individual Data

1. Wan's (2003) study is the first to research gambling addiction using individual Japanese data.
2. See Bask and Melkersson (2004) for details.

7 Tax Revenue in China and the Incentive to Declare Taxes: The Lottery Receipt Experiment

1. The significantly revised contents of this chapter entitled "The Incentive to Declare Taxes and Tax Revenue: The Lottery Receipt Experiment in China," was published by Review of Development Economics, vol.14(3) pp.611−624, August, 2010. See Wan (2010) for details.
2. See Shiller (2004) for details.
3. See Krugman (2004) for details.
4. According to Act of China Taxation, a receipt is defined as a certificate of the monetary transaction, is the primary proof for financial accounting and a tax audit, and is managed with printing, issue, and storage by the taxation bureau. The system of requiring a lottery receipt (also called as uniform invoice, Tong Yi Fa Piao in Chinese) for economic transactions appeared in Taiwan in the 1950s, in order to improve tax collection efficiency; Taiwan still uses this system today.
5. See Note 24, The Central People's Government of the People's Republic of China, March 4, 1989 for details.

6. By the end of 2002, only Beijing and Shanghai had been experimental areas at the provincial or state level, according to data from the China Taxation Bureau. Information regarding the experiments in other areas has not been reported yet as formal statistical data. The figure in Table 7.1 was obtained from the news media. Because these are not government statistics, caution is required when interpreting the information. Therefore, this table approximates the state of the experiments throughout country.
7. The inventor of the lottery receipt machine is Dai Haiping. He applied for a patent on April 28, 1998, and the China Patent Bureau authenticated the patent on February 21, 2001. This machine can issue the receipt with a special number that is used for a random drawing. The value written on the receipt is reported to the consumer, the firm, and the tax bureau simultaneously. The consumer can use the lottery receipt and the special number to investigate the status of the prize by telephone or via the internet.
8. There are some theoretical and empirical studies on the Lottery Receipt System, and see Wan (2009a, 2009b, 2009c, 2011) for details.
9. The author has also analyzed the purchase of lottery in the framework of Kahneman and Tversky (1979) and Guiggin (1991) and found the second order condition for the optimal size of lottery prize for government. See Wan (2004e) for details.
10. See Morgan (2000) for details.
11. See Jia Ma (2002)'s report entitled "new receipt in Bejing: totol prize will be 3 million Renminbi in August and September," Beijing Evening, July 18, 2002, for details.
12. This may also be because the planned sale of lottery x* was not realized.
13. See Shiling Ma and Junling Li (2002)'s report entitled "effect of receipt reform by state bureau of taxation: 900 million Renminbi increase of tax revenues brought about by 30 million lottery prize," International Finance News (affiliated by People's Daily), July 31, 2002, for details.
14. Beijing Statistic Yearbook 1999 – 2003, Tianjin Statistic Yearbook 1999 – 2003, and China Statistic Yearbook 1999 – 2003 are used.
15. $\overline{Corr}(\Delta u_{it}, \Delta u_{it-1}) = -0.5$. See p.283 of Wooldridge (2002) for details.
16. However, tax evasion is penalized in every country when it is detected by the government; thus, tax evasion is also a form of gambling.

8 Is the Life Cycle Model or Ono's Model Most Suitable for the Japanese? Analysis by Time-Series Data and Surveys of Lottery Purchase and Large Prizewinners

1. $\partial u(c_{t+1})/\partial c_{t+1} > 0$, $\partial^2 u(c_{t+1})/\partial c_{t+1}^2 < 0$, $\partial v(m_t)/\partial m_t > 0$ are assumed.
2. If β is sufficiently small, then the life cycle model is also supported in the case that the consumer is not sufficiently wealthy. See Ono (2001) for details.
3. Friedman and Savage (1948) proposed a concave–convex–concave utility function with respect to income or wealth. Within this framework, one may predict that middle-income individuals should be more likely to participate in the lottery.
4. Ono (2001) explained persistent unemployment and provided useful advice for overcoming this type of unemployment. See Ono (2001) for details.
5. This has been discussed by Horioka and Sekita (2004).

Bibliography

Ace Research Institute, Japanese Pachinko Survey, 2003.

Akita, M. and Maeda, Y. (2005) Bank's disclosure and the efficiency of allocation, *Keio University Market Quality Research Project Discussion Paper Series*, DP2005–005.

Angrist, J. D., Graddy, K., and Imbens, G. W. (2000) The interpretation of instrumental variables estimators in simultaneous equations models with an application to the demand for fish, *Review of Economic Studies*, 67(3), 499–527.

Angrist, J. D., Krueger, A. B. (1991) Does compulsory school attendance affect schooling and earnings? *Quarterly Journal of Economics*, 104(6), 979–1014.

Auld, M. C. and Grootendorst, P. (2004) An empirical analysis of milk addiction, *Journal of Health Economics*, 23(6), 1117–1133.

Bailey, M. J., Olson, M. and Wonnacott, P. (1980) The marginal utility of wealth does not increase: Borrowing, lending, and Friedman–Savage gambles, *American Economic Review*, 70(3), 372–99.

Bardsley, P. and Olekalns, N. (1999) Cigarette and tobacco consumption: Have anti-smoking policies made a difference? *Economic Record*, 75(230), 225–240.

Bask, M. and Melkersson, M. (2004) Rationally addicted to drinking and smoking? *Applied Economics*, 36(4), 373–381.

Becker, G. S., Grossman, M., and Murphy, K. M. (1994) An empirical analysis of cigarette addiction, *American Economic Review*, 84, 396–418.

Becker, G. S. and Murphy, K. M. (1988) A theory of rational addiction, *Journal of Political Economy*, 96, 675–700.

Brown, D. J. and Schrader, L. F. (1990) Cholesterol information and shell egg consumption, *American Journal of Agricultural Economics*, 74(3), 689–97.

Brunk, G. G. (1981) A Test of the Friedman–Savage gambling model, *Quarterly Journal of Economics*, 96(2), 341–348.

Caudill, S. B. (1992) More on grouping coarseness in linear normal regression models, *Journal of Econometrics*, 52, 407–417.

Chaloupka, F. J. (1991) Rational addictive behaviour and cigarette smoking, *Journal of Political Economy*, 99, 722–742.

Chaloupka, F. J., and Warner K. E. (2000) Economics of smoking, J. Newhouse and A. Culyer (eds), *The Handbook of Health Economics 1B*, Amsterdam: North-Holland, 1539–1612.

Chaloupka, F. J. and Warner, K. E. (1999) Economics of smoking, *NBER Working Paper*, No. 7047.

Chern, W. S., Loehman, E. T., and Yen, S. T. (1995) Information, health risk beliefs, and the demand for fats and oils, *Review of Economics and Statistics*, 77(3), 555–64.

Clark, A. and Fabrice E. (2002) Do health changes affect smoking? Evidence from British panel data, *Journal of Health Economics*, 21, 533–562.

Dockner, E. and Feichtinger, G. (1993) Cyclical consumption patterns and rational addiction, *American Economic Review*, 83(1), 256–263.

Decker, S. L. and Schwartz, A. E. (2003) Cigarette and Alcohol: Substitutes or Complements? *BBER Working Paper*, No. 7535.

Dranove, D., Kessler, Daniel, McClellan, Mark and Satterthwaite, Mark (2003) Is more information better? The effects of "Report cards" on health care providers, *Journal of Political Economy*, 111(3), 555–587.

Economic Planning Agency, Government of Japan, 1955–2003, *Report on National Accounts*.

Evans, W. N., Farrelly, M. C., and Montgomery, E. (1999) Do workplace smoking bans reduce smoking? *American Economic Review*, 89, 728–747.

Farrell, L., Morgenroth, E., and Walker, I. (1999) A time series analysis of U.K. lottery sales: Long and short run price elasticities,*Oxford Bulletin of Economics and Statistics*, 61(4), 513–526.

Feenstra, R. C. and Shapiro, M. D. (2001) High-frequency substitution and the measurement of price indexes, *NBER Working PaperSeries*, No. 8176.

Fenn, A. J., Antonovitz F., and Schroeter, J. R. (2001) Cigarettes and addiction information: New evidence in support of the rational addiction model, *Economics Letters*, 72, 39–45.

Fishman, M. J. and Hagerty, K. M. (2003) Mandatory versus voluntary disclosure in markets with informed and uninformed customers, *Journal of Law, Economics, and Organization* 19(1), 45–63.

Fisman, R. and Wei, S.-J. (2004) Tax rates and tax evasion: Evidence from "Missing imports" in China, *Journal of Political Economy*, 112(2), 471–496.

Friedman, M. and Savage, L. J. (1948) Utility analysis of choices involving risk, *Journal of Political Economy*, 56(4), 279–304.

Goldbaum, D. (2000) Life cycle consumption of a harmful and addictive good, *Economic Inquiry*, 38(3), 458–469.

Grossman, S. J. (1981) The informational role of warranties and private disclosure about product quality, *Journal of Law and Economics*, 24, 461–483.

Gruber, J. and Koszegi, B. (2001) Is addiction "rational"? Theory and evidence, *Quarterly Journal of Economics*, 116(4), 1261–1303.

Guiggin, J. (1991) On the optimal design of lotteries, *Economica*, 58, 1–16.

Haden, K. (1990) The demand for cigarettes in Japan, *American Journal of Agricultural Economics*, 72(2), 446–450.

Hansen, L. P. (1982a) Large sample properties of generalized method of moments estimators, *Econometrica*, 50(4), 1029–1054.

Hansen, L. P. and Singleton, K. J. (1982) Generalized instrumental variables estimation of nonlinear rational expectations models, *Econometrica*, 50(5), 1269–1286.

Hartley, R. and Farrell, L. (2002) Can expected utility theory explain gambling? *American Economic Review*, 92(3), 613–625.

Heckman, J, J. and Hotz, V. J. (1989) Choosing among alternative nonexperimental methods for estimating the impact of social programs: The case of manpower training, *Journal of the American Statistical Association*, 84, 862–874.

Hendel, I. and Nevo, A. (2001) Sales and consumer inventory, *Institute of Business and Economic Research, Economics Department Working Papers* E01–307, University of California, Berkeley.

Holman, J. A. (1998) GMM estimation of a money-in-the-utility-function model: The implications of functional forms, *Journal of Money, Credit, and Banking*, 30(4), 679–698.

Horioka, C. Y. (2002a) Stimulating personal consumption by taxation, *Nihon Keizai Shimbun*, p. 29.

Horioka, C. Y. (2002b, February) To fix economy, end consumption tax, *Daily Yomiuri*, page 9.

Horioka, C. Y. and Sekita, S. (2004) An assessment of consumption and income taxes in Japan, *Insistute of Social and Economic Research, Discussion Papers*, No. 624.

Hu, T.-W., Sung, H.-Y., and Keeler, T. E. (1995) The state antismoking campaign and the industry response: The effects of advertising on cigarette consumption in California, *American Economic Review*, 85(2), 85–90.

Ippolito, P. M. (1981) Information and the life cycle consumption of hazardous goods, *Economic Inquiry*, 19(4), 529–558.

Ippolito, P. M. and Ippolito, R. A. (1984) Measuring the value of life saving from consumer reactions to new information, *Journal of Public Economics*, 25(1), 53–81.

Ippolito, P. M. and Mathios, A. D. (1995) Information and advertising: The case of fat consumption in the United States, *American Economic Review*, 85(2), 91–95.

Japan Tobacco and Salt Corporation (1963-1999) *Tabako Senbaishi* (in English, history of tobacco monopoly), Tokyo, Volume 1-6.

Jin, G. Z. and Leslie, P. (2003) The effect of information on product quality: Evidence from restaurant hygiene grade cards, *Quarterly Journal of Economics*, 118(2), 409–451.

Kahneman, D. and Tversky, A. (1979) Prospect theory: An analysis of decision under risk, *Econometrica*, 47(2), 263–291.

Krugman, P. R. (2004, March) The misunderstanding of Chinese economy, *Harvard Business Review*, 76–82.

Lin, J. Y. (1992) Rural reforms and agricultural growth in China, *American Economic Review*, 82(1), 34–51.

Ma, J. (2002, July 18) New receipt in Bejing: totol prize will be 3 million Renminbi in August and September (in Chinese: Bei Jing Xin Ban Fa Piao: 8, 9 Yue Jiang Jin Jiang Da 300 Wan), *Beijing Evening*.

Ma, S. and Li J. (2002) Effect of receipt reform by state bureau of taxation: 900 million Renminbi increase of tax revenues brought about by 30 million lottery prize (in Chinese: Bei Jing Shui Wu Zong Ju Fa Piao Gai Ge Jian Xiao: 3,000 Wan Yuan Jiang Li Huan Hui 9 Yi Shui), *International Finance News (affiliated by People's Daily)*.

Mao, C.-S. (1990) Testing and finite sample properties of generalized method of moments Estimators: A monte carlo study, *Federal Reserve Bank of Richmond Working Paper*, No. 90–12.

Mathios, A. D. (2000) The impact of mandatory disclosure laws on product choices: An analysis of the salad dressing market, *Journal of Law and Economics*, 43(2), 651–678.

Meyer, B. D., Viscusi, W. K., and Durbin, D. L. (1995) Workers' compensation and injury duration: Evidence from a natural experiment, *American Economic Review*, 85(3), 322–340.

Milgrom, P. (1981) Good news and bad news: Representation theorems and applications, *Bell Journal of Economics*, 12, 380–391.

Ministry of Health and Welfare of Japan (1987) *Report on Smoking and Health*, 1st edn, 1987.

Ministry of Health and Welfare of Japan (1993) *Report on Smoking and Health*, 2nd edn, 1993.

Mobilia, P. (1993) Gambling as a rational addiction, *Journal of Gambling Studies*, 9(2), 121–151.

Morgan, J. (2000) Financing public goods by means of lotteries, *Review of Economic Studies*, 67, 761–784.

Morgan, J. and Sefton M. (2000) Financing public goods through lotteries: An experiment, *Review of Economic Studies*, 67, 785–810.

Ogawa, K. (2003) Economic analysis of Japanese depression (in Japanese, Daihukyo No Keizai Bunseki), *Nihon Keizai Shimbunsha*, April.

Ogawa, K. and Wan, J. (2004, November) Empirical analysis of the influence of household debt holding on consumption: Evidence from individual data of Japan National Survey of Family Income and Expenditure 1989, 1994, 1999, Osaka University, Mimeo.

Ogawa, K. and Wan, J. (2007) Household debt and consumption: A quantitative analysis based on household micro data for Japan, *Journal of Housing Economics*, 16(2), 127–142.

Olson, M. Y. (1965) *The logic of collective action: Public goods and the theory of groups*, Cambridge, Massachusetts: Harvard University Press.

Olson, M. Y. (1982) *The rise and decline of nations: Economic growth, stagflation, and social rigidities*, New Haven: Yale University Press.

Olson, M. Y. (2000) *Power and prosperity: Outgrowing communist and capitalist dictatorships*, New York: Basic Books.

Ono, Y. (2001) A Reinterpretation of chapter 17 of Keynes's general theory: Effective demand shortage under dynamic optimization, *International Economic Review*, 42(1), 207–236.

Ono, Y., Ogawa, K., and Yoshida, A. (1998) Liquidity preference and persistent unemployment with dynamic optimizing agents, *Discussion papers, Institute of Social and Economic Research Osaka University*, No. 461.

Ono, Y., Ogawa, K., and Yoshida, A. (2004) The liquidity trap and persistent unemployment with dynamic optimizing agents: An empirical evidence, *Japanese Economic Review*, 55, 355–371.

Papke, L. E. (1994) Tax policy and urban development: Evidence from the Indiana enterprise zone program, *Journal of Public Economics*, 54, 37–49.

Poterba, J. M. and Rotemberg, J. J. (1987) Money in the utility function: An empirical implementation, W. A. Barnett and K. J. Singleton (eds), *New approaches to monetary economics: Proceedings of the Second International Symposium in Economic Theory and Econometrics. International Symposia in Economic Theory and Econometrics Series*, Cambridge, New York, and Melbourne: Cambridge University Press, 219–240.

Rosenzweig, M. R. and Wolpin, K. I. (2000) Natural "natural experiments" in economics, *Journal of Economic Literature*, 38, 827–874.

Scheinkman, J. A. and Xiong, W. (2003) Overconfidence and speculative bubbles, *Journal of Political Economy*, 111(6), 1183–1219.

Shiller, R. J. (2004) Fundamental long-term risks and the new financial order, *Policy Research*, No. 10, China Center of Economic Research, Peking University.

Starmer, C. (2000) Developments in non-expected utility theory: The hunt for a descriptive theory of choice under risk, *Journal of Economic Literature*, 38(2), 332–382.

Statistics Bureau and Statistics Center, Government of Japan (1951–2003) *Consumer Price Index*.

Stigler, G. J. and Becker, G. S. (1977) De Gustibus Non Est Disputandum, *American Economic Review*, 84(3), 396–418.

The Central People's Government of the People's Republic of China (1989), Note 24 (in Chinese, Guo Wu Yuan Zhuan Fa Gai Wei Guan Yu 1989 Nian Jing Ji Ti Zhi Gai Ge Yao Dian De Tong Zhi; in English, the points of economic reform in 1989), March 4.

Verrecchia, R. (1983) Discretionary disclosure, *Journal of Accounting and Economics*, 5, 179–194.

Viscusi, W. K. (1992) *Smoking: Making the risky decision*, New York: Oxford University Press.

Wan, J. (2001, July) Testing for the hypothesis of insatiability of money liquidity utility using Japanese time series data, Osaka University, mimeo.

Wan, J. (2002a, March) rational addiction, tax Revenues and tobacco control, mimeo.

Wan, J. (2002b, August) Re-examination of rational addiction model with and without distinction between purchase and consumption, Osaka University, mimeo.

Wan, J. (2002c, September) Response to health information: A natural experiment from Japanese cigarette consumption, Osaka University, mimeo.

Wan, J. (2003, October) Testing for the preferences of participating in gambling: A case study of pinball parlor game using individual data of Japanese pachinko survey, Osaka University, mimeo.

Wan, J. (2004a, January) Rational addiction with an optimal inventory: Theory and evidence from Japanese daily and monthly purchases, *Discussion Paper in Graduate School of Economics and Osaka School of International Public Policy, Osaka University*, No. 04-01.

Wan, J. (2004b, June) Rational addiction, tax revenues and tobacco control, *Discussion Paper in Graduate School of Economics and Osaka School of International Public Policy, Osaka University*, No. 04-11.

Wan, J. (2004c, June) Response to health information: Evidence from cigarette consumption and intake of nicotine and tar in Japan,

Discussion Papers, Economics and Business, Graduate School of Economics and Osaka School of International Public Policy, Osaka University, No. 04-12.

Wan, J. (2004d, June) Responses of consumers to the mandatory disclosure of information: Evidence from Japanese inter-brand cigarette sales, *Discussion Paper in Graduate School of Economics and Osaka School of International Public Policy, Osaka University*, No. 04-13.

Wan, J. (2004e, September) Tax revenue in China and the incentive to declare taxes: The lottery purchase receipt experiment, Osaka University, mimeo.

Wan, J. (2004f, November) Are gambling and smoking complementary? Direct tests from Japanese individual data, Osaka University, mimeo.

Wan, J. (2006, August) Cigarette tax revenues and tobacco control in Japan, *Applied Economics*, 38(14), 1663–1675.

Wan, J. (2009a, August) A solution to tax evasion, CAES Working Paper Series WP-2009-009, Center for Advanced Economic Study, Fukuoka University.

Wan, J. (2009b, September) The lottery receipt experiment in China, CAES Working Paper Series WP-2009-014, Center for Advanced Economic Study, Fukuoka University.

Wan, J. (2009c, December) The lottery receipt's effect on tax declaration in urban China, CAES Working Paper Series WP-2009-016, Center for Advanced Economic Study, Fukuoka University.

Wan, J. (2010, August) The incentive to declare taxes and tax revenue: The lottery receipt experiment in China, *Review of Development Economics*, 14(3), 611–624.

Wan, J. (2011, December) The lottery receipt's effect on provincial tax revenues in China, CAES Working Paper Series WP-2011-014, Center for Advanced Economic Study, Fukuoka University.

Wooldridge, J. M. (2002) Econometric analysis of cross section and panel data, MIT Press.

Wu, D. M. (1973) Alternative tests of independence between stochastic regressors and disturbances, *Econometrica*, 41, 733–750.

Yen, S. T. and Chern, W. S. (1992) Flexible demand systems with serially correlated errors: Fat and oil consumption in the United States, *American Journal of Agricultural Economics*, 74(3), 689–697.

Yorozu, I. and Zhou, Y. (2002) The demand for cigarettes in Japan: Impact of information dissemination on cigarette consumption, *Contemporary Economic Policy*, 20(1), 72–82.

Name Index

Subject Index